Strategic Educational Planning Based on Fuzzy Cognitive Mapping and Goal Programming Technique – to Develop a Tool

A Dissertation Work

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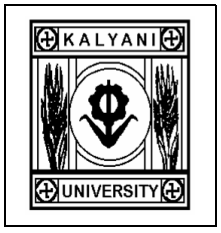

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A Few Personal Words

People, the world over who are concerned with the future of education – political leaders, administrators, teachers, students, and assorted citizens – are asking many pertinent questions today about educational planning. Before 1950 the term was scarcely known in most of the world. But since then its popularity has soared. The great majority of the world's educational leaders and governments have by now committed themselves to the idea of educational planning; international agencies are giving it a top priority, new training programmes have been set up, social scientists are doing research on the subject, and a large new professional literature is emerging. Despite all the attention, educational planning still remains an unknown to most of the people upon whom its success depends.

Educational planning as we know it today is still too young and growing too rapidly, and is far too complex and diversified a subject, to be encased in any hard and fast definition, good for all time. This is why no generally accepted definition of educational planning yet exists, much less an acceptable general theory.

Nevertheless, great progress has lately been made in both the theory and practice of educational planning, and scholars and practitioners of the subject have moved steadily toward greater agreement on many important points.

The modern conception of educational planning has attracted specialists from many disciplines. Each of them tends to see planning rather differently. Specialists and administrators in developing countries are coming to accept certain basic principles and practices that owe something to the separate disciplines but are yet a unique contribution

to knowledge by a body of pioneers who have had to attack together educational problems more urgent and difficult than any the world had ever known.

Change is steady in the world. Societal, technological, and demographic shifts are constantly impacting the population of the broader community, which in turn immediately starts a constantly moving chain reaction, which results in changes to all aspects of society. Educational institutions are not immune to this. In fact, they often feel the impact of change long before other institutions are forced to deal with it.

Strategic planning is a route that many in business and education have used as a method to plan for the future. This research project will look at the strategic planning process and show examples of how strategic planning can be used in academic planning with the help of mathematical programming.

The only never-ending fountain of blessings and encouragements of my teachers Prof. Dulal Mukhopadhyaya and Prof. Paresh Chandra Biswas (both of the Department of Education, University of Kalyani) put me in enthusiasms to take this problem as my research project. To carry out this project, I had to be stay under the constant auspicious observation of my guide Prof. Mukhopadhyaya; I cannot express my gratitude in mere words. The smiling face of Prof. Biswas provided me with all kinds of suggestions sought in every walk of my work. They not only enlightened me in my research work but also in my personal life and conduct. Actually, Prof. Mukhopadhyaya and Prof. Biswas are my friends, philosophers and guides.

Dr. Jayanta Mete, Head of the Department, Department of Education, University of Kalyani, left no stone unturned in providing me with the helps in smooth running of the project; I remain ever grateful to Dr. Mete.

Laying aside all of his important work, Prof. B. B. Pal, Department of Mathematics, University of Kalyani, spent his specious time and proficiency in helping me to formulate the mathematical programming of this project; I remain ever thankful to Prof. Pal. Mr. S.S. Gupta, member of the faculty, Department of Information Technology, JIS College, Kalyani, spent his valuable time in overcoming computational problems; in this connection I like to express my gratitude to Mr. Gupta.

Dr. Biswajit Sen and Dr. Subrata Sahoo my two friends and colleagues constantly put fuels to keep me conscious about my work; here I just can mention their names.

There are many loopholes and drawbacks of haste; I just bow my head down to beg your pardon.

The 30th June 2009, Kalyani, Nadia

(Samirranjan Adhikari)

Contents

Perspective of the Study

1.1 An Initial Characterization of Educational Planning:

Whatever educational planning is, it is certainly not a miracle drug for ailing educational systems nor, conversely, is it a devil's potion that breeds only evil. Educational planning, in its broadest generic sense, is the application of rational, systematic analysis to the process of educational development with the aim of making education more effective and efficient in responding to the needs and goals of its students and society.

Seen this light, educational planning is ideologically neutral. It is equally wrong to conceive of educational planning as being exclusively concerned with the quantitative expansion of education, with making things bigger but not different. Educational planning deals with the future, drawing enlightenment from the past. As plans for one period move into action, planning for the next must be under way, nourished by feedback from the first.

Planning is, or should be, an integral part of the whole process of educational management, defined in the broadest sense. Planning can help to attain larger and better aggregate results within the limits of available resources.

The foregoing, of course, are ideal criteria which no educational planning has ever fully lived up to. Moreover, educational institutions and the world around them were growing and changing at a considerably slower pace. It will pay us to look first, however, at some of the historical antecedents of this new educational planning.

1.2 The Ancestry of Educational Planning:

Today's educational planning can claim an unbroken ancestry running back to ancient times. Plato in his Republic offered an education plan to serve the leadership needs and political purposes of Athens. China during the Han Dynasties and Peru of the Incas planned their education to fit their particular public purposes.

These early examples emphasize the important function of educational planning in linking a society's educational system to its goals, whatever these goals may be. Some later examples show how educational planning has been resorted to in periods of great social and intellectual ferment to help chaise a society to fit new goals. The architects of such plans were usually creative social thinkers who saw in education a potent instrument for achieving reforms and attaining the 'good life'. The earliest modern attempt to employ educational planning to help realize a 'new society' was, of course, the First Five-Year Plan of the young Soviet Union in 1923. The several historical examples of educational planning cited above varied greatly in scope, objectives and complexity. All have something to teach, but none had all the features required of modern educational planning. The ancestry of today's educational planning does not end, however, with the more visible and dramatic examples just cited.

To sum up, the typical kind of educational planning that went on in most places prior to the Second World War and for many generations before had these four key features: (1) it was short-range in outlook, extending only to the next budget year (except when facilities had to be built or a major new programme added, in which case the planning horizon moved forward a bit further); (2) it was fragmentary in its coverage of the educational system; the parts of the system were planned independently of one another; (3) it was non-integrated in the sense that educational institutions were planned

autonomously without explicit ties to the evolving needs and trends of the society and economy at large; and (4) it was a non-dynamic kind of planning which assumed an essentially static educational model that would retain its main features intact year in and year out.

There were notable exceptions to the foregoing description, of course, but it is perhaps a fair picture of the mode. The important thing is that it worked. Educational institutions naturally had their share of problems and administrators their quota of headaches. But, on the whole, education ran along fairly smoothly in its accustomed groove under this regimen of simple planning. It did, that is, until the Second World War opened a new era of incredible change that was destined to touch every facet of life on man's planet, and to crack the foundations of his old institutions.

1.3 Necessity of a New Kind of Planning:

During the twenty-five years from 1945 to 1970 educational systems and their environments the world over were subjected to a barrage of scientific and technical, economic and demographic, political and cultural changes that shook everything in sight. Though our primary focus will be on the developing nations, it will help our perspective to look first at the developed world.

1.3.1 In the Industrialized Nations –

Speaking very roughly, the industrialized nations have passed through three educational phases from 1945 to 1970 and now find themselves in a perplexing fourth phase: (1) the Reconstruction Phase; (2) the Manpower Shortage Phase; (3) the Rampant

Expansion Phase; and (4) the Innovation Phase. Each yielded a new crop of planning problems.

The battle-scarred nations of Europe emerged from the Second World War with their educational systems seriously disrupted and facing a heavy backlog of educational needs. It was soon evident that conventional pre-war educational planning would not suffice for these reconstruction tasks. To cite one example: even before the war had ended, the United Kingdom-notwithstanding its decentralized system of education and its traditional lack of enthusiasm for planning in general-enacted the Education Act of 1944, which required each of the 146 local education authorities in England and Wales to prepare a development plan for submission to the central Ministry of Education. In 1946 it inaugurated comprehensive investment planning for the whole economy, then in 1951 incorporated nationwide capital planning for education into the Second Five-Year plan. Other Western European countries tackled the planning of educational reconstruction in various ways befitting their particular traditions and preferences.

Meanwhile even in the United States, where the idea of planning was still anathema, local and state education authorities resorted to more elaborate planning then ever before to handle the backlog of postponed school construction needs, to meet the educational demands of returning veterans, and to prepare for the educational consequences of the war-induced ‘baby boom’.

Educational systems were soon physically restored, but they would never return to pre-war ‘normalcy’. Soon they would find themselves in the ‘manpower business’ called upon to meet the larger and more sophisticated human resource requirements of expanding post-war economies.

The manpower phase deserves a pause, less because of its practical impact on European educational planning than because of its side effects on developing nations, and the great influence it had on arousing the interest of economists in educational development.

This led Western economists to become more manpower-minded and to look at education through new eyes. If education also helped the economy so much the better, but it should not be the economy's slave. This clinging to old forms created increasing maladjustments between educational systems and their economy, society and students. For most of the industrialized world 1967 was the year of the Great Education Explosion marked by violent student protests, sympathetically supported by many teachers, parents and other critics of traditional education. Planning that merely serves a strategy of linear expansion will no longer do; planning must now serve a strategy of educational change and adaptation.

1.3.2 In the Developing Nations –

Starting in the 1950s the developing nations responded similarly to their new circumstances, with an educational strategy of linear expansion. At a series of UNESCO conferences early in the 1960s education ministers of Asia, Africa and Latin America set ambitious regional targets for educational expansion in their respective regions to be achieved by 1980 (1975 in the case of Latin America). These targets were widely adopted by individual nations. They called for 100 per cent participation in primary education by the end of the target period, and sharply increased participation rates in secondary and higher education.

The case for a ‘manpower approach’ was particularly strong in developing nations because their over-all development was conspicuously handicapped by shortages of all kinds of specialized manpower. The trouble was, however, that these nations were not equipped to do the kind of educational and manpower planning that the situation required.

1.3.2.1 Wasteful Imbalances within the Educational System –

Typically, campaigns for expanding primary, secondary and higher education were not co-ordinated. Moreover, even at any one level the necessary flows of components (teachers, buildings, equipment, textbooks, etc.) were not carefully projected, scheduled and programmed. The inevitable result was a series of self-defeating disparities.

In one familiar type-case, school construction received an excessive priority while the expansion of teacher training and textbook supplies was short-changed. The eventual result was that the new pupils turned up in new classrooms only to find themselves with no teacher or textbooks. Sometimes the reverse happened; there were teachers and pupils but no classrooms. Almost invariably there were not enough books. With any one important component missing, the others were seriously handicapped.

In another type-case resources were poured into university expansion while secondary education lagged behind. The result was that new university places stood idle for lack of enough qualified candidates from secondary schools. Or, conversely, secondary enrolments were sharply expanded and universities were soon overwhelmed by far more entrants than they could cope with.

1.3.2.2 Demand Far in Excess of Capacity –

The setting of bold targets, the making of large promises, and the very expansion of education fired an increase in popular expectations and educational demand that fed on itself and soon got out of hand. The widening gap between educational demand and capacity was compounded by a youth population explosion which turned the original expansion targets into moving targets. While children clamouring to go to school are a joyous sight in any land, it can also be an unnerving sight for school authorities who must turn a large number of them away. There is such a thing as too much of a good thing, coming too soon. This is what happened to popular demand for education.

1.3.2.3 Costs Rising Faster than Resources –

Though this enormous popular demand was an effective political pressure for boosting education budgets, the budgets could not possibly keep pace with the rising costs and student numbers. In some countries the economic feasibility of the targets had never been tested; they rested on blind faith that somehow the necessary means for achieving them would arrive. Where they had been tested their costs had typically been under-estimated and prospective income over-estimated. Thus the targets proved economically unrealistic.

As the real facts became evident and the financial squeeze came on, there were three possible escapes. One was to cut back the initial targets, but this was politically difficult. A second was to cut costs by raising educational efficiency; this looked good in

theory but was very hard to do in practice. The third escape route was to spread available resources thinner over more and more students, but at the expense of quality and effectiveness. This was the main route taken. It permitted the statistics of enrolments to keep rising along the target path, sometimes even above it, but it seemed a dubious kind of progress when one delved behind the gross enrolment statistics and saw the shockingly high dropout and repeater rates, or visited over crowded classrooms and observed what was going on there in the name of education.

1.3.2.4 Non-Financial Bottlenecks –

Money, however, was not only the bottleneck. At least three other kinds of shortage plagued educational development in the 1960s: (a) the limited administrative abilities of educational systems to plan and to transform plans and money into desired results, (b) the long time required to recruit and develop competent staffs for new schools and universities, and (c) the limited capacity of local construction industries.

These administrative, human and physical bottle-necks became the ultimate determinants of how fast and in what directions an educational system could develop and how much financial help it could profitably absorb. Some systems found themselves in the awkward position of having large construction credits they could not spend, fine new facilities they could not staff, equipment they could not use, attractive and urgently needed schemes they could not implement. Long delays in achieving firm agreements and then actual deliveries on foreign aid projects exacerbated these difficulties.

1.3.2.5 Not Enough Jobs for the Educated –

Whatever educational philosophers may have thought were the aims of education, for most students the aim was clearly to win a good job and a good standing in the community. At first the job prospects were very good; the newly independent nations were desperately short of educated manpower of all sorts to staff their expanding government services, to replace expatriates, and to get on with the mammoth tasks of nation-building. The employment market pendulum had swung sooner and more abruptly than even the manpower experts had anticipated. The private sector, small in relation to the government as an employer of educated manpower, was creating new jobs only slowly, the more so as it turned toward labour-saving methods and equipment, sometimes prodded by new minimum wage laws. Thus the demand fell sharply, and what had been a seller's market for educational manpower turned into a buyers' market.

Selective manpower shortages continued to exist in some specialized categories, especially where no local training facilities were available. It needed re-structuring and adjusting so as to make better use of available educated manpower.

1.3.2.6 The Wrong Kind of Education –

Educators could not divest themselves of all responsibility for this employment problem, however. Instead of conditioning them for leadership in rural and agricultural development, which was indispensable to over-all national development, it would tend to alienate them from their rural surroundings.

Irrelevant education was one of the heavy prices paid for the strategy of linear expansion and for the impressively mounting enrolment statistics. The six problems just described conspired to cause a vast waste of precious economic resources and human potential, a serious handicap to national development, and millions of individual

heartaches. In retrospect, we cannot seriously fault the valiant efforts made to develop education in the 1950s and 1960s by developing nations and by those who sought to help them. Better planning would surely have helped, but no amount of planning could have drastically altered the basic constraints, compulsions and aspirations that primarily dictated the course of events. The same can be said for the industrialized nations, whose educational record in this period considering their far greater human and material resources, the greater inherent strengths of their educational systems and their considerably longer experience could hardly be said to excel the record of the developing nations.

1.4 Recent Progress in Theory and Methodology:

Discussions among educational leaders and economists in the early 1960s produced easy agreement on five propositions which formed a general framework for later explorations.

First, educational planning should take a longer range view. It should in fact have a short-range (one or two years), a middle-range (four to five years) and a long-range perspective (ten to fifteen years). Obviously its vision will grow less precise the farther ahead it looks. But considering the long 'lead time' required to increase educational capacity and to alter educational output-to enlarge, for example, the production of doctors or engineers or even of elementary school teachers it is necessary to plan years ahead.

Second, educational planning should be comprehensive. It should embrace the whole educational system in a single vision to ensure the harmonious evolution of its various parts. Moreover, it should try to extend its vision to important types of non-

formal education and training to ensure their effective integration with formal education and with the priority needs and goals of society.

Third educational planning should be integrated with the plans or broader economic and social development. If education is to contribute most effectively to individual and national development, and to make the best use of scarce resources, it cannot go its own way, ignoring the realities of the world around it.

Fourth, educational planning should be an integral part of educational management. To be effective, the planning process must be closely tied to the processes of decision-making and operations. If isolated in a back room it becomes a purely academic exercise whose chief effect is to frustrate those involved.

Fifth, (and this proposition was slower to become evident) educational planning must be concerned with the qualitative aspects of educational development, not merely with quantitative expansion. Only thus can it help to make education more relevant, efficient and effective.

Like the Ten Commandments, these five propositions soon enjoyed universal endorsement in principle, but the problem was to get them obeyed. This required three sorts of action: (1) the development of specific concepts and methodologies, (2) the training of people to apply them, and (3) the adaptation of organizational and administrative arrangements to enable planning to work. In the present section we will deal with the first of these, leaving the other two for the next section.

1.4.1 The Key Planning Questions –

As useful as they were as a starting point, the above propositions did not really address the central planning questions which every nation faces, questions which often get answered by default without ever being explicitly asked. The questions (applied to a specified time period) are essentially these:

a) What should be the priority objectives and functions of the educational system and of each of its sub-systems (including each level, each institution, each grade, each course, and each class)?

b) What are the best of the alternative possible ways of pursuing these various objectives and functions? (This involves a consideration of alternative educational technologies, their relative costs, time requirements, practical feasibility, educational effectiveness, etc.

c) How much of the nation's (or community's) resources should be devoted to education at the expense of other things? What appear to be the limits of feasibility, in terms not only of financial resources but real resources? What is the maximum of resources that education can effectively absorb in the given time period?

d) Who should pay? How should the burden of educational costs and sacrifices be distributed as between the direct recipients of education and society at large, and among different groups in society? How well adapted is the present public fiscal structure, and other sources of educational revenue, to attaining a socially desirable distribution of the burden and at the same time a sufficient flow of necessary income to education ?

e) How should the total resources available to education (whatever the amount may be) be allocated among different levels, types and components of the system (e.g. primary to secondary to higher education; technical and general education; teachers' salaries; building and equipment; textbooks, free meals, scholarships, etc.)?

Educators and economists, as well as sociologists, politicians and philosophers, are likely to approach and answer these questions in quite different ways, reflecting differences in their background, outlook and styles of thinking. Since this fact bears heavily on how different groups did approach educational planning in the last decade, we should pause to note how educational administrators and economists were inclined to think about these matters.

The good educational administrator is a hybrid of idealist, pragmatist and politician. He appreciates other important social needs, but to him education is clearly Number One; it commands his prime attention and loyalty. So at budget time he asks for all he thinks he can effectively use, plus something extra, for he knows he will get less than he asks for. To a man in this situation, most of the key planning questions posed above seem highly theoretical and impractical. Moreover they cover too broad an area; as he sees it his responsibility is to figure how much money is needed for education and how to spend it well.

The economist is preoccupied with two central problems: first, how best to divide the limited economic pie among various competing uses to get the best over-all results (the 'allocation problem'): second, how best to use these resources, once they are allocated, to get maximum output (the 'efficiency problem').

The same applies to allocation of resources within the educational system, where the top administrator himself must be the arbiter.

Thus, the economist, who identifies with the larger national interest or with the larger interests of the educational system as a whole, is constantly looking for a more rational solution to this allocation problem. The best theoretical solution to the 'allocation problem' which the economists have come up with so far is to use the Gross National Product as the central criterion and then apply a 'cost-benefit' test to each of various alternative allocation possibilities to discover which of them yields the highest ratio of benefits to costs and hence will contribute most to over-all economic output.

There are, of course, two admitted weaknesses in this cost-benefit approach, notwithstanding its persuasive logic. One is the practical difficulty of measuring costs and benefits, particularly benefits that will only be realized in the distant future. In the jargon of the trade they are called the 'social demand approach', the 'manpower approach' and the 'cost-benefit approach' (more accurately, the 'rate-of-return approach').

1.4.1.1 The 'Social Demand' Approach –

It is most commonly used to mean the aggregate 'popular' demand for education, that is, the sum total of individual demands for education at a given place and time under prevailing cultural, political and economic circumstances. For example, if a government can afford to, it can arbitrarily boost social demand by requiring school attendance and, beyond the age of compulsion, by making education free (even, in the extreme, by compensating students or their parents for the income and work forgone). Short of these measures, governments can use propaganda to stimulate the private (voluntary) demand for education. But the culture itself, the climate of attitudes and convictions about what

education can do for people, is undoubtedly the most influential factor of all in determining the social demand for education, provided people can pay for it.

Measuring social demand is almost always extremely difficult and often impossible. The UNESCO regional targets referred to earlier are a fairly good illustration of the social demand approach. One important assumption was that the popular demand for education would continue to outrun the supply. Another was that the unit costs of education would remain fairly constant. The skyrocketing of French university enrolments since the early 1950s has provided clear evidence of a sharply rising social demand for higher education.

Three main criticisms are made of the social demand approach, particularly by economists: (1) it ignores the larger national problem of resource allocation and implicitly assumes that no matter how many resources go to education this is their best use for national development as a whole; (2) it ignores the character and pattern of manpower needed by the economy and can readily result in producing too many of some types and not enough of others; and (3) it tends to over-stimulate popular demand, to underestimate costs, and to lead to a thin spreading of resources over too many students, thereby reducing quality and effectiveness to the point where education becomes a dubious investment.

1.4.1.2 The 'Manpower' Approach –

As noted earlier, many economists preferred the 'manpower approach' to educational planning. First, it gave the educational planners only limited guidance. Most manpower studies confined their attention to 'high level' manpower needed by the

‘modern sector’ (that is, mostly urban employment). The manpower approach could usefully call attention to extreme gaps and imbalances in education’s output pattern that needed remedy, but this hardly required elaborate statistical studies. This in fact was very useful for educational planners to know but it was a far cry from detailed manpower requirements.

Alert educational planners who understood the foregoing limitations soon learned to take impressive statistical tables of long-term estimates of manpower requirements, broken into fine categories, with a large fistful of salt. The inadequacies of this earlier manpower approach assumed gigantic proportions when eventually the employment market pendulum began swinging hard from manpower deficits to manpower surpluses, as described earlier. This meant that economic planning and economic development policy, no less than educational strategy, were in need of reconsideration. Some also speculated that a moderate excess of educational output over estimated manpower requirements might actually stimulate the economy to faster growth. In short, the old assumption was called into question, that the economy independently created the manpower needs while education passively responded to them. Perhaps the economy should also respond to education, and education could do some job-creating on its own.

Education could only satisfy the economy’s manpower needs and stimulate the creation of more jobs if it was the right kind of education, if it produced ‘development minded’ people with the appropriate knowledge, skills and attitudes to promote national development.

1.4.1.3 The ‘Rate-of-Return’ Approach –

Yet another group of economists, coming out of the neo-classical tradition of economists, took hard issue with the manpower approach on grounds additional to those already mentioned. They said, in effect, that this approach was about as guilty as the social demand approach of ignoring the over-all 'allocation problem' and the key test of benefits versus costs.

For one thing, the basic cost data are flimsy and critics take particular issue with including as a cost the estimated income forgone by students, especially in countries where heavy unemployment is endemic. These weaknesses on the cost side, however, are susceptible of correction as better data become available.

The more serious weaknesses, which can be somewhat lessened with improved data but never eliminated, concern the calculation of future benefits. One of the underlying (and doubtful) assumptions behind this method of calculating social benefits is that differentials in wage and salary rates are a fairly accurate reflection of the relative economic productivity of different people. A good many other heroic assumptions are required to complete the arithmetic and to reach a rate-of-return figure. The authors make clear that their method measures only the direct economic benefits and takes no account of indirect economic benefits and non-economic ones. The educational planner is left wondering what extra allowance he should make for these excluded benefits.

Curiously enough, though primary education is not in itself considered a preparation for work, a few of these rate-of-return studies, done independently in different developing countries, have reached the same conclusion-that the economic yield on primary education in those countries is considerably higher than the yield on university education. If all the other weaknesses could somehow be overcome, there

would still remain the fact that the rate-of-return approach tells the planners and decision makers only half what they need to know. None the less, the rate-of-return approach, like the social demand and manpower approaches, has a decided relevance and utility for educational planning.

1.5 Recent Progress in Putting Theory into Practice:

In addition to the broader concepts and methodologies just discussed, numerous specific techniques useful to educational planning were developed and improved during the 1960s. These included, for example: better statistical methods for making various types of projections (e.g. of enrolments, requirements for classroom facilities, teachers, equipment and materials); more reliable means for estimating future costs and financial requirements; ways of translating demographic and manpower data into future enrolment patterns.

In short, steady progress was made on enlarging the tool-kit for planning. But three other basic steps were required before these better tools could be used effectively. They were: (1) research and diagnosis to illuminate the key problems confronting educational planning; (2) the training of people who could apply these research results and planning methodologies in real situations, and (3) the creation and adaptation of organizational and administrative arrangements to enable planning to function.

It is satisfying for anyone who believes in the importance of multilateral agencies to observe that it was these agencies, UNESCO in particular, but also the OECD in the case of Western Europe, that provided the prime leadership in helping the whole world to

make substantial progress on the above three fronts during the 1960s. It may be of interest to sketch briefly what they did.

1.5.1 Training and Research –

The previously-mentioned UNESCO regional conferences early in the 1960s inspired a large volume of requests from developing nations for technical assistance in educational planning. Despite the extreme world-wide shortage of such expert personnel, UNESCO responded vigorously by sending out during the 1960s a total of more than 150 short term missions and over 140 longer-term resident advisory experts on educational planning, covering 80 countries.

There was evident need to train a cadre of more highly qualified educational planning experts for international service. To meet these needs, UNESCO set about creating a network of new training and research facilities. The IIEP's trainees, at a more advanced level, also included a good number of international expert advisers who went out to serve developing nations, and a growing number of people who went on to become teachers and research workers in educational planning in regional centres, universities and national training institutions. The IIEP also became a meeting-ground and exchange centre for the officials, scholars and students of numerous universities and other organizations that were building research and training programmes in this field.

Then in 1968 the OECD created a Centre for Educational Research and Innovation with a mandate to help its member states to bring about overdue educational reforms and innovations.

1.5.2 Implementing Planning –

Several tough questions immediately confronted the new training and research programmes: What is an educational planner? What special qualities and skills does an educational planner need? How can we convince the top people that such changes are imperative, that planning simply won't work otherwise? Educational planning, regardless of how good its methodologies may be, can never really work well unless the administrative milieu is favourable. Most were designed for rule-making and caretaking in educational systems where the central government and public authorities played only a modest role. This tended to be the case even where the central government played a major role in financing, staffing and operating the educational system. It is not surprising that in these circumstances no one really saw the educational system as a system, or tried to plan it as a whole. Not until the grip of its inertia is broken by necessary changes of attitude, structure and procedure, and not until a new planning-mindedness permeates the whole system, can planning really function well and educational development move smoothly forward. This is simply to say that educational planning is not the exclusive job of the full-time technical planners who occupy the central educational planning unit. Planning calls for a wide and efficient communications network that runs in all directions. In the last analysis, an educational system will be well planned and its plans well implemented only if those responsible for its various parts are themselves good planners, and only if each concedes that his sub-plans must be mediated and meshed with all others into a consistent and unified whole that will serve the best interests of the total system.

In more and more countries, happily, this new climate is gradually being achieved, and educational planning is becoming increasingly effective, but in some it is

still little more than a pious wish and a costly source of frustration. Those who have had an opportunity to compare educational planning efforts over a wide cross-section of nations would probably all agree that planning works best where (a) top political and educational

leaders genuinely believe in its necessity, give it their strong support, and make serious use of it in their decision-making, and (b) all others with a serious stake in the educational system-lower-level administrators, teachers, students, parents and employers have been given a fair chance for their voices to be heard in the process of formulating plans for the future.

1.6 A Look into the Future:

In particular we have examined that extraordinary slice of turbulent history since the Second World War which has created an imperative need throughout the world for drastically new approaches to educational planning. In this final section we turn to the future and ask where educational planning should go from here.

First, the three approaches discussed earlier (social demand, manpower and rate-of-return) must now be synthesized into a more coherent, unified approach.

Second, the numerous methodologies required to apply this more unified approach must be further refined and strengthened.

Third, a gigantic effort must be made by all educational systems to improve the information flows needed for effective planning.

Fourth, a larger cadre of people with broad technical competence in planning must be trained, and a general appreciation of planning must be instilled in many others whose participation in the planning process is essential.

Fifth, organizational and administrative arrangements, attitudes and behaviour patterns must be drastically altered to accommodate effective planning.

The above needs are so obvious and already so widely recognized that they will undoubtedly receive major attention in coming years. But what is perhaps not so obvious is that all of these things, though essential, will not be nearly enough, because the three approaches to educational planning considered earlier ignore one important factor.

They have usefully brought the larger outlines and relationships of the educational system into sharper focus, but they have taken much too little account of the inner life of the system and its need for drastic change.

If educational systems are to serve their students and society well, they must now make these changes in their inner life with dispatch: changes in their specific objectives and priorities, in their internal structure, content and methods, in the training and use of teachers, in the processes of teaching and learning, in the style and methods of governance and management. Moreover, some of the most pressing educational needs, involving people outside the formal educational structure, must now be faced up to more seriously and creative solutions found.

1.6.1 Refinement of Objectives –

Without clearly stated objectives and priorities there is no adequate basis either for evaluating an educational system's performance or for planning its future intelligently.

If the de facto aims of an educational system (as distinct from its stated aims) are inconsistent with its society's principal goals, maladjustments are bound to develop between the system and society, and society's needs will suffer. Likewise, if the specific objectives of various educational sub-systems are incompatible with the whole system's broader aims, then the system will be at war with itself and its basic aims will be defeated. What is more important, as one moves from the general to the particular, from the broad aims of the educational system as a whole to the more specific objectives of its particular sub-systems, it becomes easier to define objectives in operationally meaningful terms and to use these defined objectives as criteria for testing performance.

1.6.2 Evaluation of System Performance –

A clarification of educational objectives is essential not only is to ensure that the system is striving to do the right and relevant things, but to provide a basis for checking how well it actually doing them. It also affords a basis for comparing alternative ways of pursuing any particular learning objective and for determining which of these is the most efficacious.

This is half of what educational change is all about. The first half involves changing what the system is doing, to make it more relevant and up-to-date; the second half involves changing how it is doing it, to make the process more efficient and effective. An educational system can be doing the wrong things very efficiently, or it can be doing the right things very inefficiently. Both possibilities must be examined in judging its performance.

If educational systems are to make changes for the better and not simply for the sake of change, they will need a variety of diagnostic tools with which to assess their performance, identify opportunities for improvement, and monitor their progress over time.

1.6.3 A Systems Approach to Educational Planning –

Since educational systems will have to change more frequently and more rapidly than in the past, they will need new techniques for doing it. The usual way has been ad-hoc, piecemeal and episodic and has typically involved superimposing something new on top of the old, without really changing the old, as for example, adding instructional television, a language laboratory or a film projector to the conventional classroom procedures. In effect this changes the old 'teaching-learning system' but without consciously designing a new one, because it has not been looked at as a 'system'. As a result, the full potential of the new component is unlikely to be realized, its cost will be a net addition to the old costs, and the improvement in the work of the class may prove disappointing. It is as if someone, given the job of putting a man on the moon, began with the biplane and tried to add things that would get it to the moon.

The alternative approach is to use the method of 'system design', which has been used very successfully in many other fields (including actually getting some men to the moon). This works the other way round. Instead of starting with an old system that is not performing satisfactorily and trying to patch it up, it begins with a clear set of 'performance specifications', that is, with a definition of the results desired (the 'objectives') and the various controlling constraints and environmental factors to be observed (such as the background of the students, cost ceilings and time limitations). The

next step is to devise a variety of alternative possible 'systems' that might be employed to achieve the specified results. Each such potential system will involve a somewhat different combination of components (inputs) and a somewhat different technology. The estimated costs and the likely results (outputs) will also vary from system to system, and some will fit into the general context better than others. The problem then is to compare the relative advantages and disadvantages of these alternative systems and to select the one which, all things considered, seems best suited to the purpose and the circumstances. In designing new 'teaching-learning systems' in this manner to accomplish various well defined objectives, the chances are that the optimum one will usually include some combination of old things and new, fitted together in a new way. The chances are also that it will pay to test out a variety of different 'systems' for doing the same job in a number of comparable situations so that a good supply of solid evidence will be generated with which to compare their respective costs and results. It will clearly pay neighbouring educational systems to co-operate in a broad research and development programme so that they can experiment collectively in ways that none could afford alone.

The basic principles to be followed in educational systems design are clear enough, but the practical techniques still require development and testing out. Once these are available, they can become an effective part of a built-in, continuous process of educational self renewal.

1.6.4 New Management Styles and Measures –

The various measures already mentioned constitute important devices for the better management of educational systems. (Included in this concept of management are the planners, evaluators and decision makers not only in the front office of the ministry

but in every classroom as well.) But additional tools will also be needed, many of which are already within reach and simply require further refinement and testing.

Among these are the methodologies used for operations research in other fields which, properly adapted, might be profitably applied to education: programme budgeting geared to specified accomplishment targets ; the PERT system of scheduling complex projects and programmes; various methods of cost analysis and cost-effectiveness testing, and related techniques of cost-benefit analysis.

The effective planning and management of a modern educational system requires also a minimum of critical indicators which regularly reveal to all concerned what is happening to major variables and relationships within the system and to crucial relationships between the system and its environment. It is not enough to know, for example, the total number of students enrolled at each major level; it is also important to know how they are distributed geographically and by grade levels and programme areas; what changes are taking place in the profile of socio-economic background and of academic qualifications of the student body, together with key information about rates of promotion and attrition in different parts of the system.

Similarly it is not enough to know the general trend and breakdown of gross expenditures as revealed by the national education budget; it is important to know also what is happening to unit costs throughout the system, to the pattern of revenues by sources, to the relationship of educational expenditures to total public expenditures and the GNP.

If teacher supplies, costs and utilization are to be more intelligently assessed and planned, there must be indicators that reveal trends in the distribution of the teaching staff

by age, qualifications, salary levels and years of service, changes in class size in various parts of the system, and in teaching hours.

The output and effectiveness of the system must be monitored not only by indicators showing trends in the annual number of graduates of different types, but by indicators which reveal what has happened to previous graduates (and non-graduates) which is the ultimate acid test of the educational system's contribution.

What constitutes the desirable minimum of indicators of this sort will depend on what is necessary and feasible in each situation; the more sophisticated the educational system, the more extensive its management information system can be. But even the simplest and least developed educational system-or individual school or university will find it very worth while to know much more about itself than it has ever known before. Now that education has become the largest economic enterprise in most countries and a major influence on the whole economy and society, it can hardly afford to be managed in the style of a modest family business. It must operate with its eyes wide open.

1.6.5 Intensified Research and Development –

To many people, including many well acquainted with educational planning, the new frontiers just sketched may appear at first sight to lie beyond the proper boundaries of educational planning. To serve the present urgent need for educational systems to change and renew themselves in virtually every respect, the previous conception of educational planning must be broadened still further to include the planning of internal changes in these systems.

To extend educational planning in this manner will inevitably mean merging it more intimately with the processes of management, pedagogy, and research and development.

1.7 **Strategic Planning: A Brief Review of Kaufman, Herman &Watters (1996) Plan –**

According to the Greenwood Dictionary of Education (2003, p. 338), strategic planning is defined as, "a process that people engage in to define an achievable and sustainable future for their institution or organization." While this definition appears deceptively simple, there are a variety of ways that this can be approached. Models for strategic planning include Radford (1980) which is an analytical approach, Bryson (1995) which is geared towards non-profits, and Jacob (1995) which was designed for use with libraries.

1.7.1 Model for Strategic Planning –

One good model for strategic planning is by Kaufman, Herman, and Watters (1996). They divide strategic planning into ***three stages*** which are ***(a) scoping, (b) planning, and (c) implementations and continuous improvement***. Each of these stages is further divided into several smaller steps.

Despite the formulistic nature of this approach, it is important to remember flexibility in the process. When writing about strategic planning in community colleges, Howell (2000, p. 3) wrote, "The strategic planning process must be constant and fluid, with the flexibility to accommodate change in internal and external forces. Instead of focusing on a strategic plan, community colleges should emphasize strategic planning – a verb rather than a noun, an ongoing and people-cantered activity rather than a finished

product." The Kaufman, Herman, and Watters model is detailed as to an approach but an organization using it should still be able to alter the process as needed to best fit the situation at hand.

1.7.1.1 Scoping –

Scoping is divided into ***three steps*** in the Kaufman, Herman, and Watters model. These include ***(i) defining the current mission, (ii) identifying and selecting needs, and (iii) deriving the mission objective.*** Again, each of these steps has a variety of issues that need to be considered.

1.7.1.1.1 Defining the Current Mission –

Defining the current mission actually entails looking to the future and defining a mission based on an ideal vision. This mission has a clear set of conditions that are measurable and focus on results. It should also project hope and energy. Having a mission is a very important step. Without a vision-oriented mission, the strategic plan would not be a clear map into the future.

1.7.1.1.2 Identifying and Selecting Needs –

The next stage in the scoping step is to assess needs. The Kaufman, Herman, and Watters model divides this into ***nine steps***. These include (i) deciding to use data to assess needs, (ii) identifying the level of the needs assessment, (iii) identifying partners, (iv) getting the partners to participate, (v) accepting the needs assessment frame of reference, (vi) collecting data, (vii) link the needs into an assessment matrix, (viii)

prioritize the needs, and (ix) agree upon needs to be selected for inclusion on the strategic plan. All of these steps in needs assessment are important.

However, finding partners and working with them is a key point. These steps allow for feedback not only from education staff and students, but it allows key members of the community to provide feedback at the beginning in the process. This makes for a more valuable strategic plan. Hart (1988) recommended using several small groups early in the planning process. Each group could then discuss, combine, and rank their goals. Each group could then report to the larger planning body so that a sense of cohesion and consensus could be achieved.

1.7.1.1.3 Deriving the Mission Objective –

The final step in scoping is deriving the mission objective. This consists of translating the current mission into measurable performance objectives. The mission objective focuses on ends, not means. It states ***four things*** which include (i) who or what will demonstrate the performance, (ii) the performance to be demonstrated, (iii) the conditions under which the performance will be observed, and (iv) the criteria used to determine success.

1.7.1.2 Planning –

The second stage of the Kaufman, Herman, and Watters strategic planning process is planning. This is broken into ***three steps***. These are ***(i) identifying SWOTs, (ii) deriving long and short-term missions, and (iii) deriving a strategic plan.***

1.7.1.2.1 Identifying SWOTs –

The first stage of planning is identifying SWOTs. This stands for ***strengths, weaknesses, opportunities, and threats***. There are several steps in this process including identifying those strengths that are available to implement strategies, identifying those weaknesses that should be corrected, identifying opportunities that are new or have not been adequately exploited, and developing tactics to counter threats. This whole process usually takes the form of an analysis. Feinman (1999, p. 20) wrote, "Your analysis should also examine the core values of your institution. You must reflect on the traditional values in a dynamic and complex environment, assess current programs, adapt to emerging trends with the appropriate plan consistent with your vision, your mission, and your strengths as an institution, or decide not to adapt." Although Kaufman, Herman, and Watters do not reference it, environmental scans can also be used to help this process. Wrote Dougherty (2002, p. 38), "This recognition led to the use of environmental scans. The scan allows planners to take into account what is happening in the environments beyond the walls of an organization, e.g., within the community, on campus, and among groups of faculty, young adults, unsurved, and so forth."

1.7.1.2.2 Deriving Long and Short-Term Missions –

The second step in the planning stage is deriving short and long-term missions. It is important to note that Kaufman, Herman, and Watters place emphasis on two points here. (i) ***The first point*** is the idea of consensus. Since multiple stakeholders were allowed to provide input to the process, it is easier to get everyone involved to agree to missions who are based on the input of the organization and the community members. (ii) ***Second*** is the concept that the missions will be measured and everyone has agreed in advance what these measurements will be.

Kaufman, Herman, and Watters wrote (p. 116), "Ultimately, each of these long and short-term missions should be (a) based upon the now shared ideal vision, needs, and existing mission, and (b) precisely identify where the educational organization is headed, and how everyone will know when (and if) they have arrived. Because measurable criteria are used, progress toward each of the missions and ideal may be plotted and reported toward continuous improvement. Appropriate responses, resources, and en route changes may be related."

1.7.1.3 Implementations and Continuous Improvement –

The final step in the planning stage is deriving a strategic plan. Once an organization knows where it wants to go and can justify why it wants to get there, it can begin plotting the objectives required to get there. Again, these objectives are always measurable.

There are a variety of methods that can be used to generate the final strategic plan. One person can pull all the material generated by the process or it can be written by committee. Johnson (1989) described how the Phoenix public school system went about this step. It had a 25 member planning team that formulated the objectives of the strategic plan. This group included administrators, teachers, parents, support staff, and members of the community. Oddly though, no students (who are the ultimate stakeholders in the process) were included.

The final stage in the Kaufman, Herman, and Watters strategic planning model is ***implementation and continuous improvement***. These are broken down into (i) deriving tactical and operational plans, (ii) implementation, (iii) continuous improvement/formative evaluation, and (iv) determining effectiveness. Of the three stages of this model, this appears to be the most straightforward.

Tactical and operational planning looks to identify and select the best ways to accomplish objectives that were identified earlier in the strategic planning process. The purpose is to find the best route to accomplish set objectives. This is the final planning done before the implementation of the strategic plan is attempted.

Before the plan is implemented, it should be clearly communicated to the entire community. Peterson (1989, p. 3) wrote, "A strategic plan should be fully discussed and publicized before it is implemented. It is, as Hart points out, an opportunity to share the district's educational vision with the entire community."

Implementation is the actual process of carrying out the strategic plan. (Ironically, many strategic plans never get to this stage because the strategic planning document sits in a drawer somewhere…) If the strategic plan was well thought out and the appropriate resources and methods of accomplishment were selected, the plan should be accomplishable. If there are flaws in the plan, they will probably be revealed at this stage.

Continuous improvement and formative evaluation are based on the idea that all objectives have measurable outcomes. Since administrators (and everyone involved with the plan) know the desired outcome, evaluations can be done as necessary to see if the

objectives are being reached. The effectiveness of the plan can be determined and it can be continually improved as needed.

In concluding this brief overview of the Kaufman, Herman, and Watters plan, it is worth noting how important the strategic planning process can be to an institution. Wrote Peterson (1989, p. 3), "A strategic plan, after all, is not simply a document. It is a district's road map to the future. Its lines must always be true and clear."

1.8 Educational Planning –

Rapid and sometimes tumultuous change is a hallmark of today's environment. Social, technological and demographic changes have combined to dramatically alter interpersonal organizational relationships. In an effort to cope with the uncertainty created by these changes, academic institutions are giving a greater role to planning in the overall institutional managerial activities. Academic planning has generally involved itself in areas such as ***(a) forecasting, (b) budgeting, and (c) facilities optimization.*** For example, a recent special issue of Decision Sciences on academic administration contained articles on the development of marketing strategies (Krampf and Heinlein, 1981), enrolment forecasting (Gaither et al., 1981), recruiting (Kendall and Luebbe, 1981), and reallocating institutional resources (Wright and Lawless, 1981). To be sure, these are important aspects of the planning process but, in and of themselves, they are not planning nor where planning should start.

Peter Drucker, perhaps the foremost authority on organizational management today, provides some insights and guidance on how and where the planning process should start. Drucker states, "Planning starts with the objectives of the business" (Drucker, 1973, p. 126). However, the antecedent of clear, realistic, and therefore,

implementable organizational objectives is a clear definition of the mission and purpose of the organization. Thus, our academic organizations need to first ask "what is our business and what should it be?"(Drucker, 1973, pp. 77-94). The term "business" is used in its most generic sense with applications equally valid for private, public, and for non-profit organizations. While the question "what is our business?" may seem obvious, it is really quite difficult. And, in reality, few organizations ever really attempt to ask this question. Among those organizations that do, wrong answers are often given because of the discomfort involved in the process, a lack of understanding, or simply haste. The most common answer given generally evolves from the product or service that currently exists. However, the real answer lies in the customer - not in the current product or service, the current organization or its structure, or in the people in the organization.

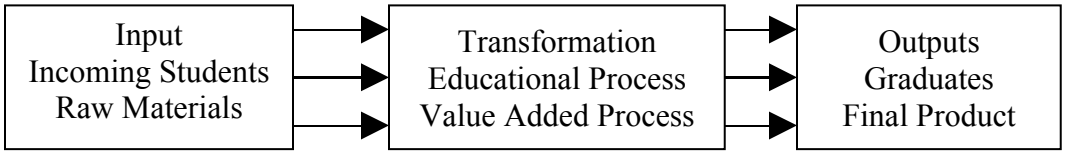
The academic organization or subunit must ask several basic but critically important questions to define what business they are in. These questions are: ***"(a) Who is the customer? (b) Where is the customer? (c) What does the customer buy? and (d) What is of value to the customer?"*** Only after these questions are answered, and answered satisfactorily, can the university as a whole and the business & technical school in particular proceed to other elements in the planning process.

1.8.1 Who is the Customer?

The first question a school must answer is: who uses the service(s) the school provides? The traditional view is that the student taking classes is obviously a customer of the school. This classification alone contains quite a variety: day students, evening students, graduate students, undergraduate students, part-time students, full-time students, individuals right out of high school, and those well past high school age. Although there

are many different types of students to occupy the school administrator, the student is just the final consumer. Peter Drucker stresses that there are almost always more customers of the organization other than the final consumers (Drucker, 1973, p. 80).

The alumni consume sports activities and continuing education; the government and business consume by consulting with faculty members as well as seeking potential employees amongst the students; the local community consumes the speaking talents of the alumni, continuing and adult educational programs, the university's facilities, etc.; and high schools, since they influence their students' selection of a university or college, must also be considered a customer.



Which view of the university is correct? Both are. The university is in both industries service and manufacturing because: (1) not all students are "final products" some never finish or some may only want bits of knowledge (courses), and (2) the raw or intermediate material is not inert but human with needs, wants, and desires.

It should be noted that the above observations are general in nature and each school must define the parameters of their interactive environment to adequately identify the set of possible customers. What is of utmost importance, however, is that sufficient effort be generated to correctly define the customers of the school or the efforts and resources devoted to the latter portions of the planning process and programs will produce suboptimal results.

1.8.2 Where is the Customer?

After defining who the customer is, the next task is to identify where the customer resides. In the university setting, one too common a sentiment is “people will beat a path to our door”. This view has been echoed by many institutions regardless of their location. In fact, this monocratic view has been prevalent for centuries. Some recent developments that have occurred, however, challenge the wisdom of this perception. In particular, two factors appear to be quite influential in terms of their impact on contemporary higher educational institutions. First, with the ready transportation, many roads and access routes prevalent today, cities no longer exist as they did in past centuries. Instead, new megalopolitan areas with major and minor hubs are emerging. Consequently, there have been shifts in population from city to suburban areas (which at one time were considered rural) and shifts in population centres (from snowbelt to sunbelt areas). Second, the education-job dichotomy no longer exists for many people. In terms of the student, the result has been that, as potential customers, they are taking a more generic view of education as knowledge, and are basing school selection decisions not just on the school itself but also on its proximity and availability. If the student is seen as a final customer, it should be realized that, over time, these customers may no longer be in close proximity to the school.

1.8.3 What is the Customer Buying?

What is the customer buying? And what is the school providing? The degree of difference between these answers will determine the rapidity with which the demise of the school could take place. In academia, a standard answer is “education, how to think, and a broadened perspective”. If this is the only answer, though, not only will the school

not be providing the correct service but it probably will remain unaware of its real competitors. In a classic article, Theodore Levitt (1960) illustrates how the railroads, because of a poor definition of what their customers were buying, remained unaware of new competition. Some institutions of higher education are also falling prey to these very same pitfalls. History is an excellent but impartial teacher. Those that do not learn *must* fail.

A student not only is purchasing an education or specific knowledge, but also a degree, entertainment and enjoyment, interaction with others, peer status, or the name of the school. Business and government organizations are in the market for individuals with certain credentials, and so forth. Thus, what a customer is buying may be apparent but is never obvious. What a customer has bought in the past may not be (or perhaps more correctly will not be) what he wants in the future.

1.8.4 What is of Value to the Customer?

The "traditional" full-time student generally is seeking credentials for a job (most often the first, real full-time job), companionship, etc. The customer does not purchase just a product or a service but purchases utility. If a new product or service that gives more utility (greater value) becomes available, whether it comes from technological change, from redesign or repackaging, its customers will opt for the new product if it better satisfies their needs.

The institutions of higher education must view their product or service and assess if it is contributing actual value or marginal value. Many universities and colleges are not adequately defining their customers, and therefore, they are not adequately providing value.

1.9 Our Business:

After the mission and purpose of an organization has been defined, the organization must ask "what will our business be?" Mustering the best sources of information possible, an impartial assessment needs to be made of the future. Forecasting, with all its pitfalls, is the tool. After we have defined where we are and where we will probably be going, we have reached the heart of the planning process. We are now ready to ask the fateful question "what should our business be?" There are no easy answers, shortcuts, forecasting or quantitative techniques to provide clear cut, unequivocal answers. Basic values and assumptions are questioned, and perhaps redefined in light of the existing environment. The quick and easy responses that have been given in the past are no longer suitable.

1.9.1 Planning for Growth –

Is education growing, declining, or just taking a slight dip? All of the previous descriptions are correct, depending upon the source of the information. If one follows traditional demographic trends and educational patterns, the last two directions would be both adequate and accurate descriptions. However, because of changing technologies, the increasing sophistication of our institutions, and the increasing numbers of professionals, alternate forms of education are increasing, both relatively and absolutely, faster than traditional education.

As our institutions of higher education have failed to meet (or even perceive) the new needs, new competitors have emerged trade associations, in-house programs, freelance educators, the American Management Association, the National Accounting Association, etc.

So, while many schools grew in size during the 1960s and 1970s, their growth was illusory because real growth only comes from increased productivity. Growth can be good, fat, or even cancerous (Drucker, 1980, p. 48). Good growth increases overall productivity; fat growth increases size or bulk but not overall productivity; and cancerous growth decreases overall productivity. Consequently, many schools that were increasing in size during this period were actually placing themselves in a worse position.

Growth can come only through systematic analyses and policies and not from erratic fits and starts caused by "jumping on the bandwagon". In developing a growth policy, several steps need to be taken. These steps emphasize a development and allocation of resources in relation to organizational capabilities.

1.9.1.1 The first step in an organizational growth policy involves not adding onto, but rather the abandoning of, the unproductive (Drucker, 1980, pp. 43-45). In many cases the unproductive may have been the best product or service in the past. But growth can only be obtained by looking forward and not backward. As Drucker states, every two or three year's products and services should be reviewed and the question asked "if we weren't in this already, would we go into it knowing what we know now?" (Drucker, 1980, p. 44). If the answer is no, strategies should be developed to abandon the product or service as quickly as possible. In this way, resources that have been tied up, people, time, and dollars, can be freed to take advantage of other more lucrative opportunities. Thus, many if not all the necessary resources can be generated internally rather than from uncertain or unpredictable external sources.

1.9.1.2 The second step in a growth policy is in the concentration of efforts (Drucker, 1980, pp. 41-43). When an organization tries to do too many things, there are never

enough resources. However, if organizational capabilities, external events, markets, etc., are carefully examined, objectives can be developed that lead to optimal payoffs for the school.

Change is a common denominator affecting all organizations. How an organization utilizes change will determine its degree of prosperity. Hence, opportunities are not stumbled upon accidentally but created by the organization itself. And, in reality, the organization faces an array of opportunities all the time - some good, some mediocre, and some poor. Thus, the final step in formulating a growth policy is the assessment of the specific strengths of the "business" (Drucker, 1979; Drucker, 1980, pp. 14-38). Only by knowing the strengths present in the people, product or service, or the structure, can the organization effectively prioritize the opportunities available.

1.10 Strategic Planning Capacity:

Education is indeed a growth industry as noted in a commentary by Peter Drucker (1981), whether to grow and to what extent is the question that colleges and universities must decide. Several trends are developing which will have an impact on current educational systems.

First, advanced education is in demand as both specialization and professionalization increase in our institutions. Therefore, professional and continuing education is necessitated (which does not necessarily occur in our present standardized units, three or four semester or quarter hour courses). ***Second,*** as our population is becoming less centralized, so must the educational environment. That is, education will become more distributed rather than centralized as in the past. ***Third,*** a "shakedown" will occur in education as it has in nearly every growth industry. New and innovative, as well

as old and venerated institutions will either cease to exist or will exist in new forms. Some schools will close their doors, new ones will open theirs, and others will merge in order to survive. These and other trends will occur whether or not institutions of higher education plan for them. And as Kotler and Murphy (1981) observe, most colleges and universities are not set up with a strategic planning capacity. They are basically good at operation that is, efficiently doing the same things day after day. Patterns of operation were traditionally established to meet the environmental conditions and opportunities; the schools' manners of conducting their affairs are likely to persist long after these procedures have lost their environment in new environments.

Therefore, developing an accurate purpose and mission for the institution is a critical first step if effective long range planning is to result. The institution should assess its purpose and mission in terms of anticipated future results and consider whether existing directions are correct in light of the external environment and organizational resources. Those institutions that do not plan will be faced by a hostile environment with threats and uncertainty lurking at every turn; however, those organizations that do plan will, in the very same environment, be confronted with a continual stream of opportunities.

We can end this section with a prediction. When someone asks, a decade or two from now, 'What is educational planning?' the answer he gets will be very different, and a good deal longer and more complex, than the transitory answer given in these pages. But one thing will be the same. The man answering the question will begin, as the present author did, by observing that educational planning is too complex and diversified a thing, and is still changing too rapidly, to fit any simple definition or to be encased in any single

general theory. And he will no doubt end by saying that, while educational planning can make valuable use of scientific methods and modes of thinking, it is none the less-like education itself-more of an art than a science.

Review of Allied Literature

Allied literature was reviewed with the aim to focus on the boundary of knowledge surrounding the three main concepts concerning educational planning: a) Strategic Planning, b) Fuzzy Cognitive Maps and c) Mathematical Programming with special emphasis to Goal Programming

2.1 Strategic Planning for Instructional Programming and Educational Planning:

In this section we review the concept of strategic planning as it can be applied to instructional programming and educational planning. It establishes that strategic planning is an important issue for educational planning due to the rapid change in the information environment in the last several decades to anticipate and plan for new changes which inevitably will be coming to the field of education in the future. A review of literature examines ideas about strategic planning from the educational field in general and library field in particular. We also review the entire concept of strategic planning broadly and list some of the possible steps that can be followed to implement a strategic planning approach.

Robinson and Robinson (1994) wrote about how strategic planning could be used for budgeting decisions. In particular, they saw this as a process to use that would allow administrators to make decisions for which library services to keep, cut back, or eliminate. Their proposed strategic planning budgeting method was based on program budgeting and cost finding techniques.

Many writers have noted that change is a constant for libraries. Morgan (1999) used this to justify strategic planning. He used this approach to look at planning for reference services, online searching, and electronic journals. He wrote (p. 33), "Few, if any, people successfully predict the future with 100 percent accuracy but there are experts who have wider perspectives than the rest of us and, consequently, are more apt to see what lies ahead. Librarians of the future will always be keeping one ear tuned to the experts and one ear tuned to their individual experiences. Use what you hear to plan your future. Your vision may not be the one everybody else sees, but at least it will provide a framework for future decision making, and will enable you and your library to evolve with our dynamic professional environment."

Feinman (1999) provides an article which discussed the importance of strategic planning for libraries. She laid out a 5-step plan for strategic planning. She wrote (p. 19), "Strategic planning is necessary for libraries. It is important to set clear direction, acknowledge all facets of competition, utilize all resources towards the main focus of the organization and understand what aspects of the competitive environment need greater attention. The plan must continually be updated and evaluated."

McClamroch et al (2001) wrote about the strategic planning approach used at the University of Indiana Libraries. It was based on John Bryson's model for non-profit

organizations. The article discussed the political nature of the process, the importance of quality leaders, and opportunities for organizational learning.

Dougherty (2001) discussed the need for libraries to engage in strategic planning rather than reacting to change. Highlights included long-range planning techniques, focusing on vision and the organizational environment, defining the planning process, including the role of the staff and prioritizing, and common pitfalls. It also featured the experiences at the Ann Arbor District Library with strategic planning.

Several articles have focused strategic planning on academic library instructional programming. While planning has long been mentioned as a key component of library instruction and information literacy programs, few articles have been specifically tailored to deal with strategic planning. However, several recent articles have addressed this issue.

Warren et al (2001) described a two-part segmentation technique that was applied to an instruction program for an academic library as part of the strategic planning process. It examined a brainstorming technique that was used to create a list of existing and possible future audiences. It then described a follow-up review session that evaluated the past years' efforts.

Booth and Fabian (2002) reviewed the issue of using strategic planning to advance curriculum goals relating to information literacy. They explored organizational structures, curriculum guidelines and standards for higher education, and suggested strategies for positioning the American College and Research Libraries (ACRL) Information Literacy standards within institutional planning documents. This

also was suggested as a means to help integrate a campus-wide adoption of information literacy standards in the institutional curriculum.

Knight (2002) recounted how assessment of a library instruction program was incorporated into strategic planning at the University of the Pacific. The project included the selection of the population, the development of learning objectives and assessment devices, and data collection and analysis. She wrote (p. 19), "Having completed the first cycle of the ongoing process of learning assessment, the library is in a position to tailor the content and delivery of subsequent iterations. Continuous improvement in library instruction can only be achieved if knowledge levels are measured at start and finish, and if the differences and means of achieving the differences are evaluated. The analysis of learning outcomes is not an end in itself, but instead must become an input to the planning process that guides future library participation in learning."

2.2 Fuzzy Cognitive Maps Educational Planning:

In a paper Vasantha Kandasamy & Promodth (1999) use Fuzzy Cognitive Maps to study the dropouts in primary education. They construct a teacher student model in primary education using some basic nature of teachers-like devoted teacher, trained teacher, untrained teacher, friendly approach of the teacher towards the student etc. In primary education, teachers play a major role in not only creating interest in small children but also vitally affect the dropouts in primary education. The authors by using the Fuzzy Cognitive Maps obtain the hidden pattern of the cause for the dropouts in primary education. The hidden pattern cannot be found out using any other method.

The unemployment problem is one, which is faced by all sections of people rich as well as poor educated as well as uneducated. The various reasons given are increase in

population, craze only on certain special courses in education (like medical, engineering), dignity of labour among educated, pay, preference for government job etc., etc. As most of the notions are uncertain and dominated by strong feelings, Vasantha Kandasamy and Subhaashree (2000) felt that Multivalent Fuzzy Cognitive Maps (MFCM) would be appropriate. Thus they take several experts opinion and convert them into MFCMs and obtain the cause of unemployment; suggestions are made from our study so that some ways can be sought to reduce the unemployment percentage of our nation. One of the striking reasons for unemployment among educated seems to be a strong craze for certain specified courses. This notion was given by several educationalists who have acted as counsellors or advisors for students who take up higher studies after school.

Fuzzy cognitive maps are used as an automated decision aid to better assess how change in one component of a system affects the other components of the same system. To illustrate the advantage of this method, a conceptual model of an eco-industrial park is presented and the fuzzy cognitive mapping approach is used to analyze the impacts of this model. The model of the eco-industrial park is a collection of industries and companies that agree to co-exist for the purpose of maintaining a sustainable economic posture in the use of natural resources and in the minimization of wastes. Industries such as a steam co-generation plant, an asphalt refinery, a salt cavern, a fish farm, and various feedlots are contained in this conceptual model. The impact assessment presented involves a total of 18 various kinds of interdependencies between and among these various industries. Impacts such as pollution, waste disposal, employment, transportation, available land, school facilities, population growth, and other economic issues are all considered in the assessment of the impacts the eco-industrial park will have on the local

community and the economy of a region that straddles northeastern Alberta and northwestern Saskatchewan, Canada. The fuzzy cognitive mapping approach is used to analyze the intricacies of these relationships and how they are likely to affect each other. (Fons, Achari Ross, 2004).

Zhang, Liu, Zhang & Wang (2006) introduces the reference theory and algorithm of text categorization by using fuzzy cognitive map (FCM), which is based on value inference and can be able to infer by combing rule and statistics. This method is flexible and robust, and we do not need train the corpus time after time, it is suitable to the text categorization of insufficiency training, new subject and multi-classification.

He, Mei Lin & Guo (2007) have presented a methodology for goal-oriented decision support. The method uses fuzzy cognitive map based on immune algorithm to find the initial state of system from among a large number of possible states. The initial state can answer the question that the course of events leads to a certain state in give scenario. Finally, an illustrative example is provided, and its results suggest that the method is capable of goal-oriented decision support.

The manner in which different societies and cultures utilise the natural environment for various activities can be myriad and complex to analyse. Whilst experience and the use of accepted methodologies have taught practitioners how to handle many of the issues and controversies linked to the sustainability impacts of proposed initiatives, many of these impacts are more controversial in nature. Systems thinking, based on fuzzy concepts, can provide some initial answers to the question of how to improve communication between heterogeneous groups of stakeholders because it demonstrates a greater respect for the knowledge of communities affected by various

regeneration initiatives. Using the 2004 Olympics as a case study, the authors report on the potential applications of fuzzy cognitive mapping as a participatory approach for collecting, analysing and representing information from multiple stakeholders. (Dodouras & James, 2007).

Educational software adoption across UK secondary schools is seen as unsatisfactory. Based on stakeholders' perceptions, this paper uses fuzzy cognitive maps (FCMs) to model this adoption context. It discusses the development of the FCM model, using a mixed-methods approach and drawing on participants from three UK secondary schools. The study presents three phases involved in the development of the model, where individual FCMs were developed in phase one and then the individual FCMs were aggregated in phase two. In phase three, further interrelationships identified from the empirical data were assigned weightings and added, resulting in the final FCM model. Following a static analysis of the model, the resulting FCM offers a visual medium of factors key to the adoption of educational software as perceived by relevant stakeholders. As a holistic model it provides insight into the context of educational software adoption in schools, which can be used to guide both educational decision-makers in where to focus their efforts and software developers in terms of more focused and appropriate software development efforts. (Hossain & Brooks, 2008)

Haoming Zhong, Chunyan Miao, Zhiqi Shen and Yuhong Feng (2008) have published a paper and this paper is concerned with the design, implementation, and evaluation of a novel extension of FCMs, temporal fuzzy cognitive maps (tFCMs). FCMs have advantages such as simplicity, supporting of inconsistent knowledge, and circle

causalities for knowledge modelling and inference. However, the lack of the time dimension limits the usage of FCMs from the long term inference and the time related knowledge modelling. In order to narrow down the gap, a temporalized FCM is proposed to define a complete discrete temporal extension of the FCM. To reduce the complexities brought by the temporalization, a design approach is also introduced to construct the map, using simplified patterns and fuzzy logic based effect functions to capture fuzzy knowledge from domain experts. The paper also discusses how the errors in the fuzzy knowledge affect the result. Two different causality models are studied in theory and experiments to compare the error effects during the inferring. The result shows a significant difference in error accumulation in different causality models and gives a guideline to help users balance the error accumulation and sensitivities of their maps.

Jose L. Salmeron (2009) proposes to build an Augmented Fuzzy Cognitive Map-based for modelling Critical Success Factors in Learning Management Systems. The study of Critical Success Factors helps decision makers to extract from the multidimensional learning process the core activities that are essential for success. Using Fuzzy Cognitive Maps for modelling Critical Success Factors provides major assistance to the e-learning community, by permitting prediction comparisons to be made between numerous tools measured by multiple factors and its relations.

2.3 Mathematical Programming for Educational Planning:

Joiner (1980) has developed a goal programming model of the planning process for a large College of Business Administration. In addition to providing the customary budget requirements for goal attainment, concepts related to cost of a constraint, trade-off information, sensitivity profiles, and complete parametric changes are discussed.

LP has received considerable attention as a means of allocating various resources within the university. In 1967, Fox (1967) proposed the use of LP model to allocate faculty between teaching and research, while Crandell (1969) used LP to aid in university housing decisions. LP was proposed by Koch (1973) in an attempt to allocate funds among university departments. The application and research of the management sciences in institutions of higher education has been surveyed by Schroeder (1973).

Although, LP has been successfully implemented to university management, the approach suffers from the fact that it does not recognize the multidimensional nature of the university management to allocate various resources for enriching the academic activities.

In the MODM area, GP (Charnes & Cooper, 1961) has appeared as a robust tool for multiobjective decision analysis and widely applied to different decision making problems. The application of GP approach to several real – life problems has been surveyed by Romero (1986). The genesis of the application of GP to academic resource allocation problems can be traced to Lee and Clayton (1972). Thereafter, GP has been widely implemented to different planning problems of academic resource management by the pioneer researchers (Franz, Lee &Van Horn, 1981; Kwak & Lee, 1998; Schroeder, 1974; Walters, Mangold & Haran, 1976), in the past. The use of pre-emptive priority based GP to long – range resource planning in university management has also been presented by Pal and Basu (Pal & Basu, 1997).

The concept of FP was first introduced by Tanaka et al. (1974) in the framework of fuzzy decision of Bellman and Zadeh (1970). Afterwards, FP approach to LP with several objectives was studied by Zimmermann (1978). During the last two decades,

various aspects of MODM problems using FP have been investigated (Bhattacharya, Rao & Tiwari, 1992; Dubois & Prade, 1980; Dyson, 1981; Hamacher, Leberling & Zimmermann, 1978; Zimmermann, 1987; Wiedey & Zimmermann, 1978).

The use of fuzzy set theory in GP was first studied by Narasimhan (1980) in 1980 and further investigated by many pioneer researchers (Hannan, 1981; Ignizio, 1982; Narasimhan, 1980) by converting the MODM problems into conventional LP problems by using the max-min operator (Bellman & Zadeh, 1970). The major drawback of such an approach is that the actual solution for achievement of the aspired levels of the goals according to their relative importance in the decision making situation can not be obtained, because the goals are often conflicting in nature in most of the real-world MODM problems.

The application of FGP approach to various real-life problems has been demonstrated by Chen and Tsai (2001). The concept of FGP formulation in the conventional form has investigated by Mohammed (1997). In the recent past, the use of conventional GP solution approach to multiobjective FP problem has been presented by Pal and Moitra (2003). In their approach, achievement of the highest membership value for each of the membership goals to the extent possible on the basis of importance has been taken into account. The approach has been further extended by Moitra and Pal (2002), Pal and Moitra (2003a), Pal and Biswas (2004). The FGP approach to land use planning in agricultural system has been recently studied by Biswas and Pal (2005).

Conceptual Frame Work of the Study

Gaining knowledge from the survey of allied literature the present researcher has considered three concepts a) Strategic Planning, b) Fuzzy Cognitive Maps and c) Mathematical Programming with special emphasis to Goal Programming.

Since a discussion about "Strategic Planning" has been placed in the 1st chapter; now the other two are being presented here.

3.1 Fuzzy Cognitive Mapping:

Fuzzy cognitive mapping (FCM) is a process where the participant(s) list the factors that they perceive as important to a particular issue and then draw the causal relationships among these factors. Instead of a dichotomous yes-no (affects or doesn't affect) the fuzzy aspect allows people to weight the causal relationships, which usually cannot be known precisely, but are described as occurring a little, somewhat, a lot, etc. Anyone can freely draw causal pictures, or cognitive maps, of problems or systems of any kind. FCM is applicable for analyzing complex problems that involve the

interrelationships between various aspects of society such as economics, environment and politics (Nakamura et al., 1982). FCM is especially appropriate in soft knowledge domains (e.g. political science, military science, history, international relations, organization theory) where both the system concepts/relationships and the meta-system language are fundamentally fuzzy (Kosko, 1986). For example, FCMs have been used to model organization behaviour and job satisfaction (Craiger et al., 1996) and to suggest ways to improve decision making in sport-fisheries management (Radomski and Goeman, 1996).

3.1.2 A Brief History of FCM –

Cognitive mapping takes its roots from graph theory put forward by Euler in 1736. Harary et al. (1965) put this theory into use in quantitative anthropology to make a structural analysis of observations. The structural analyses were done on maps called "digraphs". Later the political scientist Robert Axelrod (1976) changed these graphs from the subjective interpretations of anthropologists to the observations of individuals. These graphs, which Axelrod called "***cognitive maps***", were coded from text or were first-hand experiences verbally stated by informants.

Kosko (1986) opened the way to a more rigorous analysis of cognitive maps through the use of neural network analysis. Maps can be simulated under different scenarios via signal processing which then becomes an auto-associative memory. He coined the term fuzzy cognitive maps (FCM) for these maps with weighted connections. Carley (1988) put forward some of the statistical techniques so that stakeholders and different groups of people could be compared and contrasted through their cognitive maps. Cognitive mapping has been used to examine decision making processes and

complex social systems (Axelrod, 1976; Bauer, 1975; Bougon et al., 1977; Brown, 1992; Carley and Palmquist, 1992; Cossette and Audet, 1992; Hart 1977; Malone, 1975; Montazemi and Conrath, 1986; Nakamura et al., 1982). These studies opened the way for using cognitive maps to represent local knowledge systems as told by informants (Ozesmi, 1999).

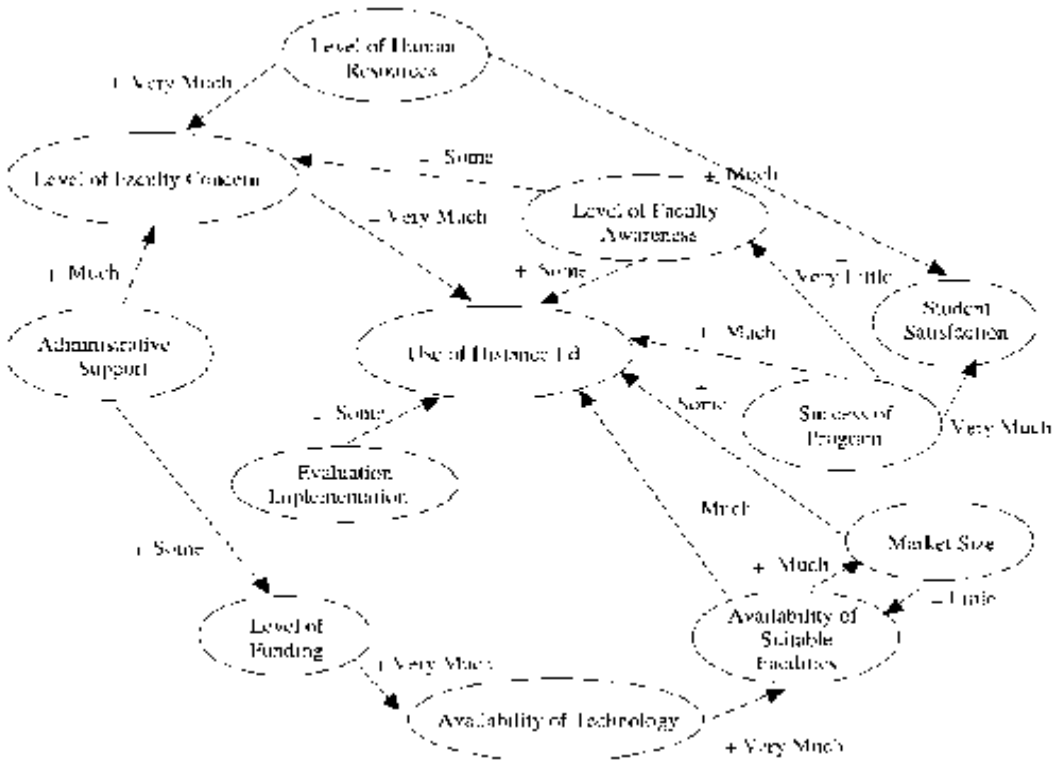


Figure – 3.1: Showing FCM concerning Distance Learning (Cole and Persichitte, 2000)

3.2 Multi-Objective Optimization:

Multi-objective optimization (or programming), (Steuer, 1986; Sawaragi, Nakayama and Tanino,1985) also known as ***multi-criteria*** or ***multi-attribute*** optimization, is the process of simultaneously optimizing two or more conflicting objectives subject to certain constraints.

Multi-objective optimization problems can be found in various fields: product and process design, finance, aircraft design, the oil and gas industry, automobile design, or wherever optimal decisions need to be taken in the presence of trade-offs between two or more conflicting objectives. Maximizing profit and minimizing the cost of a product; maximizing performance and minimizing fuel consumption of a vehicle; and minimizing weight while maximizing the strength of a particular component are examples of multi-objective optimization problems.

If a multi-objective problem is well formed, there should not be a single solution that simultaneously minimizes each objective to its fullest. In each case we are looking for a solution for which each objective has been optimized to the extent that if we try to optimize it any further, then the other objective(s) will suffer as a result. Finding such a solution, and quantifying how much better this solution is compared to other such solutions (there will generally be many) is the goal when setting up and solving a multiobjective optimization problem.

3.2.1 Mathematical Introduction –

In mathematical terms, the multiobjective problem can be written as:

$$\begin{aligned} &\min_{x} \left[\mu_1(x), \mu_2(x), \ldots, \mu_n(x)\right]^T \\ &s.t. \\ &g(x) \leq 0 \\ &h(x) = 0 \\ &x_l \leq x \leq x_u \end{aligned}$$

where μ_i is the i^{th} objective function, g and h are the inequality and equality constraints, respectively, and x is the vector of optimization or decision variables. The

solution to the above problem is a set of Pareto points. Pareto solutions are those for which improvement in one objective can only occur with the worsening of at least one other objective. Thus, instead of a unique solution to the problem (which is typically the case in traditional mathematical programming), the solution to a multi-objective problem is a (possibly infinite) set of Pareto points.

A design point in objective space $\boldsymbol{\mu}^*$ is termed Pareto optimal if there does not exist another feasible design objective vector $\boldsymbol{\mu}$ such that $\mu_i \leq \mu_i^*$ for all $i \in \{1, 2, ..., n\}$, and $\mu_j < \mu_j^*$ for at least one index of j, $j \in \{1, 2, ..., n\}$.

3.2.2 Solution Methods –

Now let us discuss some if the solution methods.

3.2.2.1 Constructing a Single Aggregate Objective Function (AOF) –

This is perhaps the most intuitive approach to solving the multi-objective problem. The basic idea is to combine all of the objective functions into a single functional form, called the AOF. A well-known combination is the weighted linear sum of the objectives. One specifies scalar weights for each objective to be optimized, and then combines them into a single function that can be solved by any single-objective optimizer (such as SQP, pattern search etc.). Clearly, the solution obtained will depend on the values (more precisely, the relative values) of the weights specified. For example, if we are trying to maximize the strength of a machine component and minimize the production cost, and if we specify a higher weight for the cost objective compared to the strength, our solution will be one that favours lower cost over higher strength. Thus, it may be

noticed that the weighted sum method is essentially subjective, in that a decision manager (DM) needs to supply the weights. Moreover, this approach cannot identify all non-dominated solutions. (Only solutions located on the convex part of the Pareto front can be found). The objective way of solving multi-objective problems requires a Pareto-compliant ranking method, favouring non-dominated solutions, as seen in current multi-objective evolutionary approaches such as NSGA-II and SPEA2. Here, no weight is required and thus no a priori information on the problem is needed. (Deb, 2002)

3.2.2.2 Goal Programming –

Goal programming is a branch of multi-objective optimization, which in turn is a branch of multi-criteria decision analysis (MCDA), also known as multiple-criteria decision making (MCDM). This is an optimization programme. It can be thought of as an extension or generalisation of linear programming to handle multiple, normally conflicting objective measures. Each of these measures is given a goal or target value to be achieved. Unwanted deviations from this set of target values are then minimised in an achievement function. This can be a vector or a weighted sum dependent on the goal programming variant used. As satisfaction of the target is deemed to satisfy the decision maker(s), an underlying satisfying philosophy is assumed.

3.2.2.2.1 History –

Goal programming was first used by Charnes, Cooper and Ferguson in 1955, although the actual name first appear in a 1961 text by Charnes and Cooper. Seminal works by Lee (1972), Ignizio (1976), Ignizio and Cavalier, (1994) and Romero (1991) followed. Schniederjans gives in a bibliography of a large number of pre-1995 articles

relating to goal programming, (Scniederjans, 1995) and Jones and Tamiz give an annotated bibliography of the period 1990-2000 (Jones & Tamiz, 2002).

The first engineering application of goal programming, due to Ignizio in 1962, was the design and placement of the antennas employed on the second stage of the Saturn V. This was used to launch the Apollo space capsule that landed the first men on the moon.

3.2.2.2.2 Variants –

The initial goal programming formulations ordered the unwanted deviations into a number of priority levels, with the minimisation of a deviation in a higher priority level being infinitely more important than any deviations in lower priority levels. This is known as lexicographic or pre-emptive goal programming. Ignizio (1976) gives an algorithm showing how a lexicographic goal programme can be solved as a series of linear programmes. Lexicographic goal programming should be used when there exists a clear priority ordering amongst the goals to be achieved.

If the decision maker is more interested in direct comparisons of the objectives then Weighted or non pre-emptive goal programming should be used. In this case all the unwanted deviations are multiplied by weights, reflecting their relative importance, and added together as a single sum to form the achievement function. It is important to recognise that deviations measured in different units cannot be summed directly due to the phenomenon of incommensurability.

Hence each unwanted deviation is multiplied by a normalisation constant to allow direct comparison. Popular choices for normalisation constants are the goal target value

of the corresponding objective (hence turning all deviations into percentages) or the range of the corresponding objective (between the best and the worst possible values, hence mapping all deviations onto a zero-one range) (Romero, 1991). For decision makers more interested in obtaining a balance between the competing objectives, Chebyshev goal programming should be used. Introduced by Flavell in 1976, this variant seeks to minimise the maximum unwanted deviation, rather than the sum of deviations. This utilises the Chebyshev distance metric, which emphasizes justice and balance rather than ruthless optimisation.

3.2.2.2.3 Strengths and Weaknesses –

A major strength of goal programming is its simplicity and ease of use. This accounts for the large number of goal programming applications in many and diverse fields (Jones & Tamiz, 2002). As weighted and Chebyshev goal programmes can be solved by widely available linear programming computer packages, finding a solution tool is not difficult in most cases. Lexicographic goal programmes can be solved as a series of linear programming models, as described by Ignizio and Cavalier (Ignizio, 1976).

Goal programming can hence handle relatively large numbers of variables, constraints and objectives. A debated weakness is the ability of goal programming to produce solutions that are not Pareto efficient. This violates a fundamental concept of decision theory that is no rational decision maker will knowingly choose a solution that is not Pareto efficient. However, techniques are available (Hannan, 1980; Romero, 1991; Tamiz, Mirrazavi & Jones, 1999) to detect when this occurs and project the solution onto the Pareto efficient solution in an appropriate manner.

The setting of appropriate weights in the goal programming model is another area that has caused debate, with some authors (Gass, 1987) suggesting the use of the Analytic Hierarchy Process or interactive methods (White, 1996) for this purpose.

Model Formation and Tool Development

From the quick survey of the allied literature we can see that in formulating the strategic planning in the field of educational planning "Fuzzy Cognitive Mapping" and "Goal Programming" have been mainly utilized individually; but the present researcher has an insight that there are much scope of formulating strategic planning in the field of educational planning by utilizing the contributions "Fuzzy Cognitive Mapping" and "Goal Programming" in combination. Hence, the venture to formulate a "model" for strategic planning on education has been launched.

4.1 Decisions Based on Fuzzy Cognitive Mapping:

Cognitive Maps (CMs) were introduced by Axelrod in the late 1970s (Axelrod, 1976). FCMs models are created as collections of concepts and the various causal relationships that exist between these concepts. The concepts are represented by nodes and the causal relationships by directed arcs between the nodes.

In FCMs, although the degree of the causal relationships could be represented by a number in the interval [-1, 1], each concept, in a binary manner, could be either activated or not activated. Certainty Neuron Fuzzy Cognitive Maps (CNFCMs) are introduced (Tsadiras and Margaritis, 1997), to provide additional representing capabilities to FCMs, by allowing each concept's activation to be activated just to a degree.

4.1.2 Development of a Fuzzy Cognitive Map for Educational Planning –

The construction method of the FCM should follow rules that ensure its reliability. Furthermore, because the FCM is created by the personal opinions and points of view of the expert(s) on the specific topic, the reliability of the model is heavily depended on the level of expertise of the domain expert(s).

After extended interviews and long discussions with the expert, the list of the concepts that are identified as playing important role in Educational Planning and should appear in the FCM, are the following: C_1, C_2, … C_n

After structured procedures of filling in of specific questionnaires by our domain expert, the causal relationships that exist between the concepts above are identified and put as in the following tabular form.

Table – 4.1: Showing the Weights of the Arcs

Concept/Weight	**C_1**	**C_2**	**….**	**C_n**
C_1	W_{11}	W_{12}	**….**	W_{1n}
C_2	W_{21}	W_{22}	**….**	W_{2n}
…	**….**	**….**	**….**	**….**
C_n	Wn_1	Wn_2	**….**	W_{nn}

4.1.3 Analysis of FCM –

Analysis of FCM is to be done in two ways a) calculation of Node's Importance and b) determination of Density of the map.

4.1.3.1 Node's Importance –

Graph Theory provides the notion of node's importance (Axelrod, 1976) that assists the static analysis of FCMs. Node's importance gives an indication of the

importance that the node/concept have for the model, by measuring the degree to which the node is central to the graph. The importance of a node 'i' is evaluated as –

$$imp\ (i) = in\ (i) + out\ (i)$$

where in (i) is the number of incoming arcs of node i and out (i) is the number of out-coming arcs of node 'i'.

4.1.3.2 Density –

Another way to examine statically the FCM's graph is by calculating its density (Hart, 1977). The density 'd' is defined as –

$$d = \frac{m}{n(n-1)}$$

Where m is the number of arcs in the model and n is the number of concepts of the model. Density gives an indication of the complexity of the model. Typical values of density are in the interval [0.05, 0.3].

4.2 Decisions Based on Goal Programming:

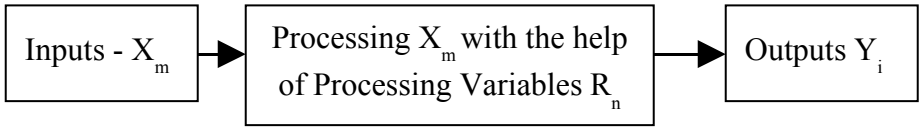
At first "Concepts" of the previous section are classified as variables in the following categories:

Variables – Concepts act here as variables as their numerical values may take any positive values.

Input Variables (X_m) – The Concepts, which act as input in the educational process (if there be any) should be identified.

Process Variables (R_n) – The Concepts, which act as process variables in the educational process (some must be there) should be identified.

Output Variables (Y_i) – The Concepts, which act as output variables in the educational process (some must be there) should be identified.



The objective of the work is to find a solution (levels of input and process variables) to satisfy the quality characteristics of the output to a maximum extent subject to the constraints on input and process variables. Each of the input, process and output variables may be bounded by lower limit and upper limit or bounded by lower/upper limit only.

The relationships among input, process and output variables are obtained by the following equations framed with the help of the "weights of the arcs" (taking weights from table – 4.1) –

$$\mathbf{C_n = \Sigma W_{in} \times C_i \ [Sum \ is \ done \ for \ i = 1, \ldots, n]}$$

where C_ns are Concepts and W_{ij} s are weights.

Objectives and constraints are framed with the help of the above equations; output variables determine objectives and input as well as process variables determine constraints.

The researcher will use the pre-emptive method to optimize objectives.

4.3 Tool Development:

The proposed model may be used as a tool in educational planning. Following steps should be taken to formulate the educational planning of an educational institution:

a) "Steps of Strategic Planning" as proposed by Kaufman, Herman, and Watters (1996) should be followed (as it has been discussed in the 1st chapter repetition is avoided).

b) With the consultation of domain experts concepts concerning educational planning for the particular institution should be chalked out.

c) Considering the opinion of the domain experts concerning the relations among the chalked out concepts "Fuzzy Cognitive Map" for educational planning should be developed (standard method to develop weighted Fuzzy Cognitive Map should be adopted).

d) Chalked out concepts should be considered as variables (concepts act here as variables as their numerical values may take any positive values).

e) Variables are to be classified into categories: (i) Input Variables, (ii) Process Variables and (iii) Output Variables.

f) The relationships among input, process and output variables are obtained by the equations framed with the help of the "weights of the arcs" of the FCM.

g) Objectives and constraints should be framed with the help of the above equations; output variables determine objectives and input as well as process variables determine constraints; hence Goal Programming should be developed.

h) A suitable method of optimization should be considered to solve the Goal Programming.

An Example

The proposed "model" may be tested with a real example.

5.1 Decisions Based on Fuzzy Cognitive Mapping:

Cognitive Maps (CMs) were introduced by Axelrod in the late 1970s (Axelrod, 1976). FCMs models are created as collections of concepts and the various causal relationships that exist between these concepts. The concepts are represented by nodes and the causal relationships by directed arcs between the nodes.

In FCMs, although the degree of the causal relationships could be represented by a number in the interval [-1, 1], each concept, in a binary manner, could be either activated or not activated. Certainty Neuron Fuzzy Cognitive Maps (CNFCMs) are introduced (Tsadiras and Margaritis, 1997), to provide additional representing capabilities to FCMs, by allowing each concept's activation to be activated just to a degree.

5.1.2 Development of a Fuzzy Cognitive Map for Educational Planning –

The construction method of the FCM should follow rules that ensure its reliability. Furthermore, because the FCM is created by the personal opinions and points of view of the expert(s) on the specific topic, the reliability of the model is heavily depended on the level of expertise of the domain expert(s). In this case the present researcher used the Questionnaire method (Roberts, 1976), which involves interviews and

filling in of questionnaires by experts. The expert, a senior Professor of the Department of Education, University of Kalyani, Kalyani, Nadia has provided the actors and factors of the FCM, as well as the possible alternative scenarios to be imposed to the system.

After extended interviews and long discussions with the expert, the list of the concepts that were identified as playing important role in Educational and should appear in the FCM, are the following:

C_1: Simplicity of Learning Environment

C_2: Collaboration (between students, between teachers, between students and teachers)

C_3: Administrative/Technical Support

C_4: Curricular Load

C_5: Institutional Policy to Achieve the Clearly Defined Goal

C_6: Teacher /Student Ratio

C_7: Size of the Class

C_8: Quality of Education in Question of Value Addition to Fulfil the Demand of the Job market

C_9: Student Satisfaction (Acquiring Knowledge, Choice of Vocation, Life Satisfaction)

After structured procedures of filling in of specific questionnaires by the domain expert, the causal relationships that exist between the concepts above were identified. The weights of the arcs are given in Table – 1.

Table – 5.1: Showing the Weights of the Arcs

Concept/Weight	**C_1**	**C_2**	**C_3**	**C_4**	**C_5**	**C_6**	**C_7**	**C_8**	**C_9**
C_1	0.0	0.0	0.0	-0.3	0.3	0.0	0.0	0.1	0.3
C_2	0.2	0.0	0.4	0.0	0.4	0.0	0.0	0.4	0.4
C_3	0.2	0.3	0.0	0.0	0.3	0.2	0.3	0.2	0.3
C_4	0.0	0.0	0.0	0.0	0.2	-0.2	-0.2	0.2	-0.2

C_5	0.3	0.3	0.4	-0.2	0.0	0.2	0.2	0.3	0.4
C_6	0.0	0.3	0.1	0.0	0.0	0.0	0.3	0.2	0.2
C_7	0.0	0.0	0.0	0.0	0.0	-0.3	0.0	-0.2	-0.2
C_8	0.2	0.4	0.4	-0.3	0.4	0.3	-0.3	0.0	0.4
C_9	0.4	0.3	0.3	0.3	0.4	-0.3	-0.2	0.4	0.0

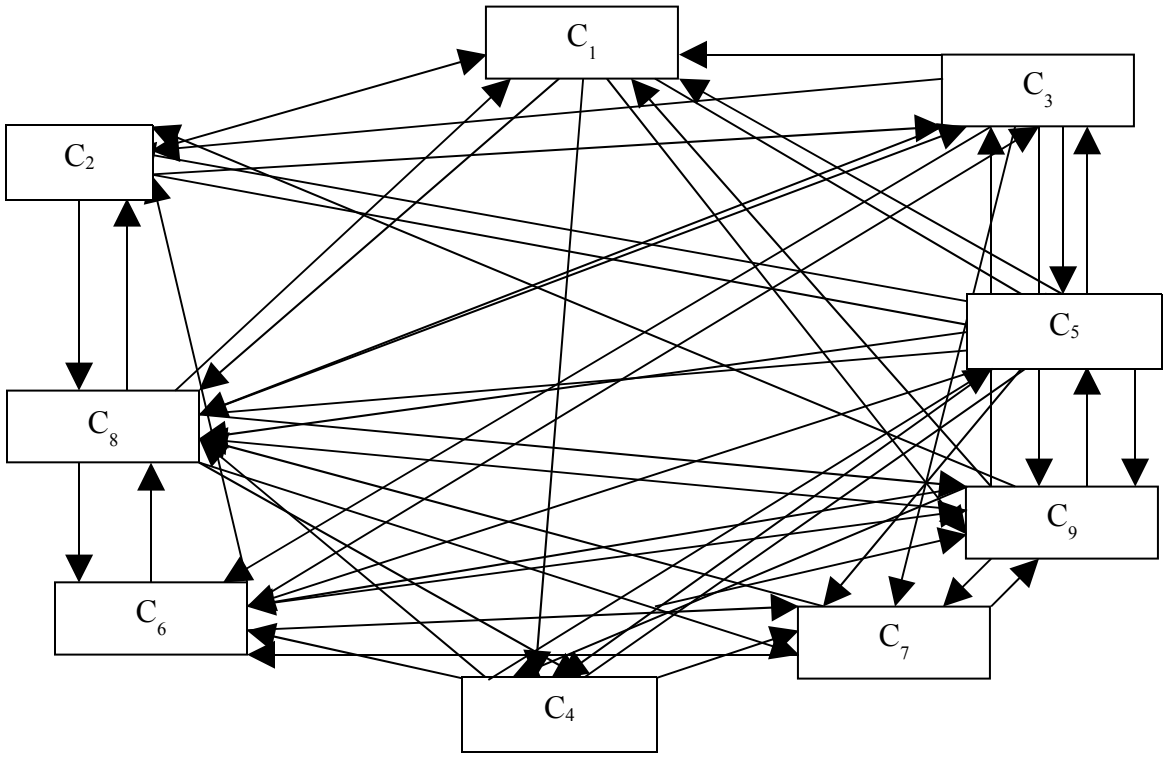


Figure – 5.1: Showing graph of the FCM

5.1.3 Analysis of FCM –

Static analysis of FCM was done.

5.1.3.1 Node's Importance –

Graph Theory provides the notion of node's importance (Axelrod, 1976) that assists the static analysis of FCMs. Node's importance gives an indication of the

importance that the node/concept have for the model, by measuring the degree to which the node is central to the graph. The importance of a node 'i' is evaluated as –

$$imp\ (i) = in\ (i) + out\ (i)$$

where in(i) is the number of incoming arcs of node 'i' and out(i) is the number of out-coming arcs of node 'i'. According to this definition, the importance of the nodes is given in Table – 2. It is found that the most central/important concept is ***C_8: "Quality of Education in Question of Value Addition to Fulfil the Demand of the Job market" and C_9: "Student Satisfaction (Acquiring Knowledge, Choice of Vocation, Life Satisfaction)"***, followed by C_5: "Institutional Policy to Achieve the Clearly Defined Goal".

Table – 5.2: Showing the Importance of Nodes

	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	**Total No. of Arcs**
In	5	5	5	4	6	6	6	8	8	**53**
Out	4	5	7	5	8	5	3	8	8	**53**
Total	**9**	**10**	**12**	**9**	**14**	**11**	**9**	**16**	**16**	**106**

5.1.3.2 Density –

Another way to examine statically the FCM's graph is by calculating its density (Hart, 1977). The density d is defined as

$$d = \frac{m}{n(n-1)}$$

Where m is the number of arcs in the model and n is the number of concepts of the model. Density gives an indication of the complexity of the model. Typical values of density are in the interval [0.05, 0.3]. The density here is **53/ (9×8) = 0.736**, which is

extremely high and gives an indication of the great complexity of the problem that it represents.

5.2 Decisions Based on Goal Programming:

In the present example C_8 and C_9 are the output variables whereas C_1, C_2, C_3, C_4, C_5, C_6, C_7 are process variables; here input variables were absent.

From table – 1 the researcher had found –

$C_8 = 0.1 \times C_1 + 0.4 \times C_2 + 0.2 \times C_3 + 0.2 \times C_4 + 0.3 \times C_5 + 0.2 \times C_6 - 0.2 \times C_7$

$C_9 = 0.3 \times C_1 + 0.4 \times C_2 + 0.3 \times C_3 - 0.2 \times C_4 + 0.4 \times C_5 + 0.2 \times C_6 - 0.2 \times C_7$

$C_1 = 0.2 \times C_2 + 0.2 \times C_3 + 0.3 \times C5 + 0.2 \times C_4 + 0.3 \times C_5$

$C_2 = 0.3 \times C_3 + 0.3 \times C_5 + 0.3 \times C_6$

$C_3 = 0.4 \times C_2 + 0.4 \times C_5 + 0.1 \times C_6$

$C_4 = -0.3 \times C_1 - 0.2 \times C_5$

$C_5 = 0.3 \times C_1 + 0.4 \times C_2 + 0.3 \times C_3 + 0.2 \times C_4$

$C_6 = 0.2 \times C_3 - 0.2 \times C_4 + 0.2 \times C_5 - 0.3 \times C_7$

$C_7 = 0.3 \times C_3 - 0.2 \times C_4 - 0.2 \times C_5 - 0.3 \times C_6$

Priority – 1 (P_1): Maximize C_8 (Quality of Education in Question of Value Addition to Fulfil the Demand of the Job market)

Priority – 2 (P_2): Maximize C_9 (Student Satisfaction)

Mathematically, the two objectives are given as –

Maximize $P_1 = 0.1 \times C_1 + 0.4 \times C_2 + 0.2 \times C_3 + 0.2 \times C_4 + 0.3 \times C_5 + 0.2 \times C_6 - 0.2 \times C_7$

Maximize $P_2 = 0.3 \times C_1 + 0.4 \times C_2 + 0.3 \times C_3 - 0.2 \times C_4 + 0.4 \times C_5 + 0.2 \times C_6 - 0.2 \times C_7$

Subject to:

$0.2 \times C_2 + 0.2 \times C_3 + 0.3 \times C5 + 0.2 \times C_4 + 0.3 \times C_5 \leq 1$

$0.3 \times C_3 + 0.3 \times C_5 + 0.3 \times C_6 \leq 1$

$0.4 \times C_2 + 0.4 \times C_5 + 0.1 \times C_6 \leq 1$

$-0.3 \times C_1 - 0.2 \times C_5 \leq 1$

$0.3 \times C_1 + 0.4 \times C_2 + 0.3 \times C_3 + 0.2 \times C_4 \leq 1$

$0.2 \times C_3 - 0.2 \times C_4 + 0.2 \times C_5 - 0.3 \times C_7 \leq 1$

$0.3 \times C_3 - 0.2 \times C_4 - 0.2 \times C_5 - 0.3 \times C_6 \leq 1$

$C_1, C_2, C_3, C_4, C_5, C_6, C_7 \geq 0.25$♦

The researcher solved the problem in three steps with the help of **LINGO** software.

Step-1: LP_1 was solved

Maximize $P_1 = 0.1 \times C_1 + 0.4 \times C_2 + 0.2 \times C_3 + 0.2 \times C_4 + 0.3 \times C_5 + 0.2 \times C_6 - 0.2 \times C_7$

Subject to:

$0.2 \times C_2 + 0.2 \times C_3 + 0.3 \times C5 + 0.2 \times C_4 + 0.3 \times C_5 \leq 1$

$0.3 \times C_3 + 0.3 \times C_5 + 0.3 \times C_6 \leq 1$

$0.4 \times C_2 + 0.4 \times C_5 + 0.1 \times C_6 \leq 1$

$-0.3 \times C_1 - 0.2 \times C_5 \leq 1$

$0.3 \times C_1 + 0.4 \times C_2 + 0.3 \times C_3 + 0.2 \times C_4 \leq 1$

$0.2 \times C_3 - 0.2 \times C_4 + 0.2 \times C_5 - 0.3 \times C_7 \leq 1$

$0.3 \times C_3 - 0.2 \times C_4 - 0.2 \times C_5 - 0.3 \times C_6 \leq 1$

$C_1, C_2, C_3, C_4, C_5, C_6, C_7 \geq 0.25$♦

Result is presented in the following table – 3.

Table – 5.3: Showing Concept Values to Maximize Objective Value i.e., Maximum of C_8: (Quality of Education in Question of Value Addition to Fulfil the Demand of the Job market) = 1.55

Concept	Value
C_1: Simplicity of Learning Environment	0.25
C_2: Collaboration (between students, between teachers, between students and teachers)	**1.28**
C_3: Administrative/Technical Support	0.25
C_4: Curricular Load	**1.68**
C_5: Institutional Policy to Achieve the Clearly Defined Goal	**0.59**
C_6: Teacher /Student Ratio	**2.49**
C_7: Size of the Class	0.25

From the discussion with the experts the lower limit was fixed to 0.25

From the discussion with the experts the lower limit was fixed to 0.25

From the table – 3 it is clear that to maximize the value of C_8 (Quality of Education in Question of Value Addition to Fulfil the Demand of the Job market) to 1.55 we have to increase the value of **C_6** (Teacher /Student Ratio) to 2.49, **C_4** (Curricular Load) to 1.68, **C_2** (Collaboration) to 1.28 and **C_5** (Institutional Policy) to 0.59; whereas the values of the other variables should be kept minimum to 0.25 only.

Step-2: LP_2 was solved

Maximize $P_2 = 0.3\times C_1+0.4\times C_2+0.3\times C_3-0.2\times C_4+0.4\times C_5+0.2\times C_6-0.2\times C_7$

Subject to:

$$0.2 \times C_2 + 0.2 \times C_3 + 0.3 \times C5 + 0.2 \times C_4 + 0.3 \times C_5 \leq 1$$

$$0.3 \times C_3 + 0.3 \times C_5 + 0.3 \times C_6 \leq 1$$

$$0.4 \times C_2 + 0.4 \times C_5 + 0.1 \times C_6 \leq 1$$

$$-0.3 \times C_1 - 0.2 \times C_5 \leq 1$$

$$0.3 \times C_1 + 0.4 \times C_2 + 0.3 \times C_3 + 0.2 \times C_4 \leq 1$$

$$0.2 \times C_3 - 0.2 \times C_4 + 0.2 \times C_5 - 0.3 \times C_7 \leq 1$$

$$0.3 \times C_3 - 0.2 \times C_4 - 0.2 \times C_5 - 0.3 \times C_6 \leq 1$$

$$C_1, C_2, C_3, C_4, C_5, C_6, C_7 \geq 0.25 \text{ ♦}$$

Table – 5.4: Showing Concept Values to Maximize Objective Value i.e., Maximum of C_9: (Student Satisfaction in Acquiring Knowledge, Choice of Vocation, Life Satisfaction) = 1.75

Concept	Value
C_1: Simplicity of Learning Environment	**2.58**
C_2: Collaboration (between students, between teachers, between students and teachers)	0.25
C_3: Administrative/Technical Support	0.25
C_4: Curricular Load	0.25
C_5: Institutional Policy to Achieve the Clearly Defined Goal	**1.42**
C_6: Teacher /Student Ratio	**1.67**

♦ From the discussion with the experts the lower limit was fixed to 0.25

C_7: Size of the Class	0.25

From the table – 4 it is clear that to maximize the value of C_9 (Student Satisfaction in Acquiring Knowledge, Choice of Vocation, Life Satisfaction) to 1.75 we have to increase the value of $\mathbf{C_1}$ (Simplicity of Learning Environment) to 2.58, $\mathbf{C_6}$ (Teacher /Student Ratio) to 1.67 and $\mathbf{C_5}$ (Institutional Policy) to 1.42; whereas the values of the other variables should be kept minimum to 0.25 only.

Step-3: LP_3 was solved

Maximize $P_2 = 0.3\times C_1+0.4\times C_2+0.3\times C_3-0.2\times C_4+0.4\times C_5+0.2\times C_6-0.2\times C_7$

Subject to:

$$0.2 \times C_2 + 0.2 \times C_3 + 0.3 \times C5 + 0.2 \times C_4 + 0.3 \times C_5 \leq 1$$

$$0.3 \times C_3 + 0.3 \times C_5 + 0.3 \times C_6 \leq 1$$

$$0.4 \times C_2 + 0.4 \times C_5 + 0.1 \times C_6 \leq 1$$

$$-0.3 \times C_1 - 0.2 \times C_5 \leq 1$$

$$0.3 \times C_1 + 0.4 \times C_2 + 0.3 \times C_3 + 0.2 \times C_4 \leq 1$$

$$0.2 \times C_3 - 0.2 \times C_4 + 0.2 \times C_5 - 0.3 \times C_7 \leq 1$$

$$0.3 \times C_3 - 0.2 \times C_4 - 0.2 \times C_5 - 0.3 \times C_6 \leq 1$$

$$C_1, C_2, C_3, C_4, C_5, C_6, C_7 \geq 0.25^{\blacklozenge}$$

(**Additional Constraint**) $0.1\times C_1+0.4\times C_2+0.2\times C_3+0.2\times C_4+0.3\times C_5+0.2\times C_6-0.2\times C_7>1.55$

$$C_1, C_2, C_3, C_4, C_5, C_6, C_7 \geq 0.25$$

Table – 5.5: Showing Concept Values to Maximize Objective Value i.e., Maximum of C_9: (Student Satisfaction in Acquiring Knowledge, Choice of Vocation, Life Satisfaction) Subject to the Additional Constraint that C_8 will Remain Maximized (i.e. $C_8 > 1.55$) = 1.0167

Concept	Value
C_1: Simplicity of Learning Environment	0.25
C_2: Collaboration (between students, between teachers, between students and teachers)	**1.29**
C_3: Administrative/Technical Support	0.25
C_4: Curricular Load	**1.67**
C_5: Institutional Policy to Achieve the Clearly Defined Goal	**0.58**

$^{\blacklozenge}$ From the discussion with the experts the lower limit was fixed to 0.25

C_6: Teacher /Student Ratio	**2.50**
C_7: Size of the Class	0.25

From the table – 5 it is clear that to maximize the value of C_9 (Student Satisfaction in Acquiring Knowledge, Choice of Vocation, Life Satisfaction) Subject to the Additional Constraint that C_8 will Remain Maximized (i.e. C8 >1.55) to 1.0167 we have to increase the value of **C_6** (Teacher /Student Ratio) to 2.50, **C_4** (Curricular Load) to 1.67, **C_2** (Collaboration) to 1.29 and **C_5** (Institutional Policy) to 0.58; whereas the values of the other variables should be kept minimum to 0.25 only.

To have an easy and clear picture of the result all the findings of table – 3, 4 & 5 were put in a consolidated table – 6. In table – 6 values of the concepts were normalized by dividing each value by 0.25 (lower limit as set in the programming).

Table – 5.6: Showing Consolidated form of the tables – 3, - 4 & - 5

Concept	Step - 1 Value	Step -2 Value	Step -3 Value	Step - 1 Value*	Step -2 Value*	Step -3 Value*
C_1: Simplicity of Learning Environment	0.25	**2.58**	0.25	1	**10**	1
C_2: Collaboration	**1.28**	0.25	**1.29**	**5**	1	**5**
C_3: Administrative/Technical Support	0.25	0.25	0.25	1	1	1
C_4: Curricular Load	**1.68**	0.25	**1.67**	**7**	1	**7**
C_5: Institutional Policy to Achieve the Clearly Defined Goal	**0.59**	**1.42**	**0.58**	**2**	**6**	**2**
C_6: Teacher /Student Ratio	**2.49**	**1.67**	**2.50**	**10**	**7**	**10**
C_7: Size of the Class	0.25	0.25	0.25	1	1	1

* **Normalized Value ~ Value/ 0.25**

From the table – 6 it is clear that to maximize the value of C_8 (Quality of Education in Question of Value Addition to Fulfil the Demand of the Job market) to 1.55 we have to increase the value of **C_6** (Teacher /Student Ratio) to 2.49, **C_4** (Curricular Load) to 1.68, **C_2** (Collaboration) to 1.28 and **C_5** (Institutional Policy) to 0.59; whereas the values of the other variables should be kept minimum to 0.25 only. The ratio of the normalized value of the concepts (C_1, C_2, C_3, C_4, C_5, C_6 & C_7) was 1: 5: 1: 7: 2: 10: 1.

From the table – 6 it is clear that to maximize the value of C_9 (Student Satisfaction in Acquiring Knowledge, Choice of Vocation, Life Satisfaction) to 1.75 we have to increase the value of **C_1** (Simplicity of Learning Environment) to 2.58, **C_6** (Teacher /Student Ratio) to 1.67 and **C_5** (Institutional Policy) to 1.42; whereas the values of the other variables should be kept minimum to 0.25 only. The ratio of the normalized value of the concepts (C_1, C_2, C_3, C_4, C_5, C_6 & C_7) was 10: 1: 1: 1: 6: 7: 1.

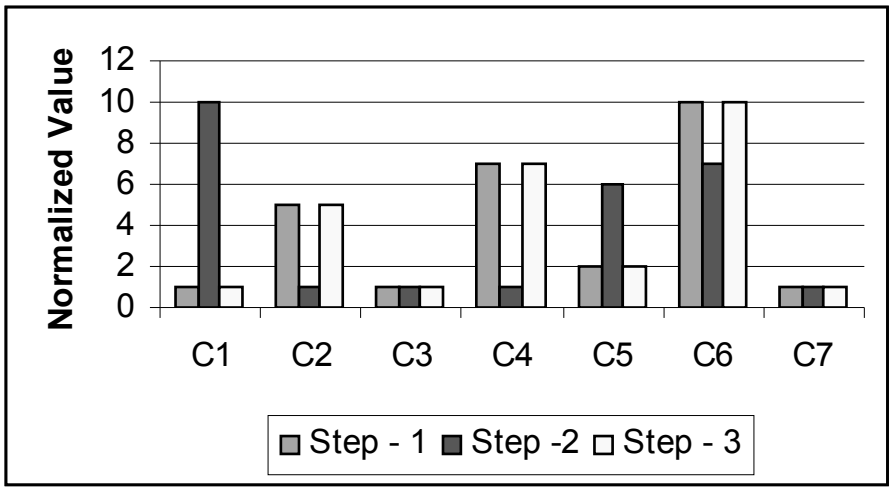


Figure – 5.2: Showing bar diagram depicting the normalized values of processed variables

From the table – 6 it is clear that to maximize the value of C_9 (Student Satisfaction in Acquiring Knowledge, Choice of Vocation, Life Satisfaction) Subject to

the Additional Constraint that C_8 will Remain Maximized (i.e. C8 >1.55) to 1.0167 we have to increase the value of **C_6** (Teacher /Student Ratio) to 2.50, **C_4** (Curricular Load) to 1.67, **C_2** (Collaboration) to 1.29 and **C_5** (Institutional Policy) to 0.58; whereas the values of the other variables should be kept minimum to 0.25 only. The ratio of the normalized value of the concepts (C_1, C_2, C_3, C_4, C_5, C_6 & C_7) was 1: 5: 1: 7: 2: 10: 1.

In all of the three steps the concepts C_5 (Institutional Policy to Achieve the Clearly Defined Goal) and C_6 (Teacher /Student Ratio) were demanded to be increased; C_1 (Simplicity of Learning Environment), C_4 (Curricular Load) and C_2 (Collaboration) were conflicting concepts; C_3 (Administrative/Technical Support) and C_7 (Size of the Class) remained indifferent or neutral.

Discussion and Conclusion

6.1 Discussion:

From the results of the present study it is clear that –

i) To maximize the "Quality of Education" (in Question of Value Addition to Fulfil the Demand of the Job market) we have to increase the value of $\mathbf{C_6}$ (Teacher /Student Ratio), $\mathbf{C_4}$ (Curricular Load), $\mathbf{C_2}$ (Collaboration) and $\mathbf{C_5}$ (Institutional Policy); whereas the values of the other variables should be kept minimum as prefixed by the researcher.

To maintain the quality of education "Teacher /Student Ratio" should be increased, "Curricular Load" is to be augmented, "Collaboration (between students, between teachers, between students and teachers)" is to be maintained with high standard and "Institutional Policy" should be clear to attain the predefined goal of the institution.

ii) To maximize the value of "Student Satisfaction" (in Acquiring Knowledge, Choice of Vocation, Life Satisfaction) we have to increase the value of $\mathbf{C_1}$ (Simplicity of Learning Environment), $\mathbf{C_6}$ (Teacher /Student Ratio) and $\mathbf{C_5}$ (Institutional Policy); whereas the values of the other variables should be kept minimum as prefixed by the researcher.

To satisfy the students "Simplicity of Learning Environment" should be increased, "Teacher /Student Ratio" is to be augmented, and "Institutional Policy" should be clear to attain the predefined goal of the institution.

iii) To maximize the value of "Student Satisfaction" (in Acquiring Knowledge, Choice of Vocation, Life Satisfaction) subject to the additional constraint that C_8 will remain maximized we have to increase the value of $\mathbf{C_6}$ (Teacher /Student Ratio), $\mathbf{C_4}$ (Curricular Load), $\mathbf{C_2}$ (Collaboration) and $\mathbf{C_5}$ (Institutional Policy); whereas the values of the other variables should be kept minimum as prefixed by the researcher.

To satisfy the students as well as to maintain high quality of education simultaneously "Teacher /Student Ratio" should be increased, "Curricular Load" is to be augmented, and "Institutional Policy" should be clear to attain the predefined goal of the institution.

iv) In all of the three steps the concepts "Institutional Policy" (to Achieve the Clearly Defined Goal) and "Teacher /Student Ratio" were demanded to be increased; "Simplicity of Learning Environment", "Curricular Load" and "Collaboration" (between students, between teachers, between students and teachers) were conflicting concepts; "Administrative/Technical Support" and "Size of the Class" remained indifferent or neutral.

6.2 Conclusion:

After a thorough discussion with the domain experts the researcher came to the conclusion that the demand of good "Institutional Policy" (to achieve the clearly defined goal) and a sufficiently large "Teacher /Student Ratio" was justified. In a country like India education is till mostly in a welfare sector; government run academic institutions are aimed mainly at increasing the humane aspects of education; whereas the authorities privately managed institutions are mainly framing their policies towards gaining profit to a maximum extent – they are trying to satisfy the student at the cost if the quality of education. Hence, the findings of the present study may be justified and the validity of the proposed model may also be established.

6.3 Limitations of the Study:

As the work was time bound there were several limitations of the study. Due to scarcity of time the researcher was compelled to shortcut the work. As academic planning is a prime needed subject and judicially the planning is to be formulating with utmost care. The futures of the students as well as that of the institution depend largely on proper academic planning. So, before formulating a planning most rigorous probing into model is both necessary and sufficient conditions.

Here, only a model had been proposed with mathematical footings; but probing of the same had been done in haste. Human decision making is a complex phenomenon; in the present mathematical model human decision making simulated by the fuzzy logic (i.e., by developing Fuzzy Cognitive Map). The researcher only presented an example – to use the proposed model in actual situation the academicians have –

a) To chalk out the concepts relevant to the needs and objectives of the institution;

b) To developing Fuzzy Cognitive Maps by taking opinions from the experts of different organs of the academic system;

c) To amalgamate the several developed Fuzzy Cognitive Maps into a consolidated one;

d) To run the static and dynamic analysis (by simulation) if the Fuzzy Cognitive Maps;

e) To formulate the Goal Programming problem with several important objectives;

f) To solve the Goal Programming problem with the help of modern software techniques;

g) To validate the results found in the form of optimum solutions corroboration is to be done with the opinion of the domain experts.

But in the present work all the steps were not followed rigorously and some of those were skipped in haste.

6.4 Suggestions for Further Study:

To overcome the limitations of the present study further research is to be done; some of directions suggested by the researcher were placed as below –

a) Fuzzy Cognitive Map may be developed with the help of Analytic Hierarchy Method (Saaty, 1977).

b) Dynamic study of Fuzzy Cognitive Map may be done with the help of "Simulation Technique".

c) Instead of "Goal Programming" in "Fuzzy Goal Programming" more accurate results may be obtained.

d) Experts from several domain of education may be consulted to get more reliable "Fuzzy Cognitive Map".

e) To validate the findings students' opinion may also be considered.

f) Fuzzy Goal Programming Approach for deriving priority weights in the Analytical Hierarchy Process (AHP) Method may be used.

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